Young Chinese-English Bilinguals' Use of Home Touchscreen Apps and Bilingual Language Development in England

Kexin Cheng

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Faculty of Social Science
School of Education

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Abstract

This study investigates language and home touchscreen experiences among children in Chinese heritage families in England. It explores the influence of touchscreen activities on the language choices of these bilingual/multilingual children, with an emphasis on parental involvement. Six Chinese heritage families with 3-7-year-old children participated in this study.

Combining both the digital ethnography and the case study approaches, family interviews (including a language portrait activity), parent-recorded videos, and evolving mediagrams were conducted with participating families. Collection duration varied (4-8 months) with each family. Between each interview, parents recorded videos of their children's home touchscreen activities. Collaboratively drawn mediagrams illustrated each child's home touchscreen activities and language involvements in an evolving way.

This study contributes to the understanding of the in-depth touchscreen and language experiences of a specific ethnic group, Chinese heritage children aged 3 to 7 in England. By valuing both the perspectives of children and parents, the study comprehensively examines their digital literacy experiences, reflections on the benefits and challenges of using apps in different languages, and the children's multilingual development across various digital activities. Family language policies, parental mediation strategies, and attitudes towards touchscreens influence bilingual children's varied touchscreen use and language development. While common touchscreen activities like watching cartoons and using educational apps can facilitate monolingual/bilingual development, only limited heritage language touchscreen resources, compared to English touchscreen resources, are used in some families. In addition, I examined how Bronfenbrenner's bioecological model can be applied to understand the complexity of bilingual children's language development and digital practices.

The findings of my study may inspire parents and practitioners to select appropriate apps to meet children's diverse developmental needs. Moreover, further research is needed to understand bilingual children's touchscreen literacy practices in both home and school settings, as well as how to bridge the gap between home and school. The use of digital and non-digital activities in these children's lives should also be explored.

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Glossary

Terms	Definitions
Early childhood education and care (ECEC)	All officially regulated programs that offer educational and caring services for children ranging from infants to the age of mandatory primary school entrance.
Family Language Policy (FLP)	The thoughtful and clear planning of how languages are used within a household and among the members of the family.
Heritage language (HL)	A minority language that children always develop via daily communications and literacy practices within the home environment.
Language Portrait (LP)	A visual demonstration of a person's linguistic and cultural identity, including identifying languages/cultures related to a person's identity, choosing colours to represent each language/culture, and painting these colours to a body silhouette image.

Chapter 1. Introduction

1.1 Personal motivation and evolving research interest

During a weekend I spent with my three-year-old cousin while pursuing my master's degree in London, he showed me his new favourite toy, a mini iPad. I observed him effortlessly switching between apps on his iPad, choosing videos to watch, and imitating the characters' speech in the cartoons in English. I was surprised since all the family members mainly spoke Chinese to him, and I seldom heard him speaking English. This scene reminded me of my own personal experience when I was little. As a child born and raised in a monolingual environment in China, I first accessed the language English by watching the Disney videotapes that my parents bought for me when I was about four years old. I often imitated some simple lines of cartoon characters, and it did help me generate interest in English. When I began to learn English in primary school, I felt that I was already familiar with lots of pronunciations, and I could speak simple textbook conversations fluently without many efforts. Back to my childhood, I always had a positive attitude towards technology. Personally speaking, I believe digital technology is a vital tool and useful way for children to access and explore the outside world while staying at home. These personal experiences sparked my initial curiosity in understanding how a child could develop languages through digital technologies, especially through the engagement with touchscreens that implemented multiple functions within one device.

Similar to my young cousin, studies have found that many children started using touchscreen devices from a young age in their daily lives in the current era (K. Choi et al., 2021; Chowsomchat et al., 2023; Pham & Lim, 2019). Several studies have discovered that engaging with some touchscreen apps and activities at home may facilitate their language and literacy development with parental support (Mifsud et al., 2021; Scott, 2022). Linked back to my own experience of watching these videotapes that my parents bought for me, my mother often communicated with me in Chinese when I watched cartoons. From my perspective, the multiple supports from parents in facilitating a child's language development at home through both digital and non-digital activities are crucial. Since it is the first place where children engage in a variety of activities, the home environment significantly impacts their lives and affects their emergent literacy (Morgade et al., 2019; Siibak & Nevski, 2019).

Research has recognised the significant roles of parents and other close family members on children's touchscreen use (Marsh et al., 2018; Siibak & Nevski, 2019). Meanwhile, parents play a crucial role in promoting their children's digital language and literacy development. Acting as not only gatekeepers but also enablers and instructors (Little, 2020), parents' attitudes and mediation strategies can greatly influence children's touchscreen activities (Ozturk & Ohi, 2022). Therefore, I wanted to embed my study within a child's most intimate surroundings, the home environment.

Although I was raised in a Chinese monolingual family, I had the opportunity to develop my English skills through family digital resources and my school education. Viewing myself as a Chinese-English bilingual, I gradually grew an interest in understanding how a young bilingual child, like my young cousin, could develop both languages from a young age. As I am pursuing my PhD in the UK and I may share some common cultural beliefs and language experiences with Chinese heritage families who immigrate to the UK, I want to understand more about the experiences of these Chinese heritage families in particular.

Driven by my personal motivation and the related literature, my research interest gradually evolved and formed a clear picture for conducting my PhD study. In short, my study aims to gain an in-depth understanding of how young Chinese heritage

children practise and develop their languages at home through their family touchscreen activities, with a focus on the parents' role.

In the following sections of this introduction, I will introduce the context of my study and the importance of my research topics. Next, I will discuss the potential research gaps and how my study addresses these problems. Then, I will introduce my research objectives and questions and my methodological design. Following that, I will outline the main contribution to knowledge of my study. Finally, I will illustrate the structure of my whole thesis.

1.2 Research context

1.2.1 Chinese heritage families

Within the UK context, the Chinese ethnic group is an increasing and inseparable part of British society. The Chinese population of England and Wales by the latest 2021 Census of the UK (Office for National Statistics, 2021) is 445,646, which is 7% of the total population. With China's growth of global economic and political status in recent years, more new immigrants and international students who mainly speak Mandarin Chinese come to the UK, and the importance of Mandarin Chinese increases in the British Chinese community (Curdt-Christiansen & Huang, 2021). It is vital to gain deeper understandings of the language experiences within Chinese heritage families in the UK.

For heritage language (HL) speakers, their HLs are always less represented in society compared to the dominant language (Rothman, 2007). In British society, while English is the dominant language, for the Chinese heritage families, Chinese is regarded as a heritage language that is less used in social and school environments. As home and community environments can be vital in a young speaker's HL maintenance, it is important to investigate how Chinese as a HL is maintained and developed within the intimate family environment.

When exploring these young HL children's home language choices, the lens of their Family Language Policies (FLPs) (Curdt-Christiansen, 2009) is frequently applied. FLP strategies in a family offer insights on the thoughtful plans of language use within this household and among family members (Curdt-Christiansen & Gao, 2021). One important branch of FLP has been established to investigate how languages are intentionally or unintentionally organised, negotiated, and practised within family literacy activities, aiming to transmit HLs (Wang & Hamid, 2022). When researching FLP within Chinese heritage families, several studies have identified the significant role of parents' language ideologies, as well as some specific strategies and challenges they encountered while making efforts to their children's HL maintenance (Huang & Liao, 2024; Liang & Shin, 2021; Shen & Jiang, 2021; Y. Wang, 2023). Within some families, translanguaging (García & Otheguy, 2020) practices that involve both languages take place to facilitate family communications both during traditional (Karpava et al., 2021) and digital activities (Zhao & Flewitt, 2020). My research adapts this FLP approach when understanding the specific language choices of children in each family, valuing the special and unique language practices of Chinese heritage families in the UK.

1.2.2 Children's touchscreen adoption

As mentioned previously, my research aims to understand not only how languages are practised and developed in these Chinese heritage families, but also to emphasise the children's language choices through their family touchscreen activities.

Touchscreen devices have been commonly accessed and frequently used in many children's daily lives on a global scale (Chen et al., 2020; Dardanou et al., 2020; Day et al., 2024; Liszkai-Peres et al., 2024; Scott, 2022). It is vital to acknowledge the importance of touchscreen adoption in children's lives in the UK as well. According to the Ofcom reports on children's media use and parental attitudes in the UK, a significant increase in children's touchscreen use is found: 96% of the children aged from 5 to 7 years old went online in 2023, and the figure was only 79% back in 2017 (Ofcom, 2017, 2024).

The influence of the COVID-19 pandemic may have changed the patterns of children's touchscreen use (Day et al., 2024). During the pandemic, a significant increase in children's touchscreen time at home was found (Sun et al., 2022; Vanderloo et al., 2020; Wiederhold, 2020). For instance, within the UK context, the pandemic greatly impacted children's education, requiring many children to finish their schoolwork through online platforms at home (Ofcom, 2022). When looking into the post-pandemic period, some studies found that the parents' mediation on children's touchscreen use tended to be more restricted compared to during the pandemic (Day et al., 2024). Instead of focusing on the length and frequency of children's touchscreen engagement, how Chinese heritage parents mediate their children's touchscreen use and language practices during these activities is carefully investigated in my study.

Moreover, a growing number of touchscreen apps are designed to target children (Colliver et al., 2020; Livingstone et al., 2019). During the third quarter of 2022, 3.55 million apps were available on Google Play, and around 1.6 million apps were available in the Apple App Store worldwide (Statistica, 2022a), with 9.79% of the apps in the Apple App Store belonged to the category of education (Statistica, 2022b). Studies have identified various touchscreen activities and apps that children engage with at home. Within the UK context, according to the latest Ofcom report (2024), among children aged 5-7, there was an increase in the use of apps for various activities compared to the previous year, such as messaging or making video/voice calls, watching live streaming apps/websites, using social media apps, and playing online games. Therefore, by acknowledging the diverse touchscreen activities and multiple choices of apps, it is important to understand each child's touchscreen activities in a specific family background. In my study, I include all the touchscreen devices that a child has access to at home, such as tablets (e.g., iPad), mobile phones, and smart watches, and investigate specific touchscreen activities and app adoptions of each child.

1.2.3 Digital literacy

The frequent and common access to various touchscreen activities and apps offers many children a chance to develop their digital literacy (Marsh, 2019). Developing digital literacy skills is crucial for children's future learning and development (Neumann, 2016). Apart from traditional reading and writing skills, digital literacy highlights the interactive feature of digital communication (Soyoof et al., 2024). In my study, not only are traditional literacy skills of reading and writing included in Chinese heritage children's touchscreen digital literacy practices, but how they practise multiple oral language skills during these multimodal touchscreen activities is also explored, along with both interpersonal communication and communication with touchscreens.

Children can form rich digital literacy practices through the multimodal meaning-making process with various digital resources (Marsh, 2019). Some well-designed apps can support children's digital literacy through multiple modes, such as changing screen layout, sound, and animation (Dowdall, 2019; Jewitt & Kress, 2003). Several

studies have identified that many touchscreen activities can enhance children's digital literacy (Farrugia & Busuttil, 2021; Ozturk & Ohi, 2022).

In bilingual home environments, children's touchscreen experiences can be complicated, as their language choices are influenced by the exposures to multiple languages from birth (Genesee, 2023). Studies have also spotted the unique benefits of using proper touchscreen apps in facilitating children's bilingual digital literacy practices (Al Salmi & Gelir, 2024; Harrison & McTavish, 2018; Mifsud et al., 2021). For HL families, how touchscreen apps are used to facilitate children's bilingual development can be largely influenced by parents' attitudes to and mediation of touchscreen adoption and on languages (Soyoof, 2022). It is vital to understand parents' role in facilitating their children's touchscreen activities and language choices in heritage families with specific ethnic backgrounds (Little, 2019).

1.3 Research gaps and the present study

Following the introduction of my research backgrounds with literature, I want to identify some potential research gaps and discuss how my study addresses these gaps. First, Little (2019) identified the need for further research in comprehending the touchscreen digital literacy experiences of bilingual children in heritage families within specific ethnic groups and communities. In my study, the participating families all belong to a narrow ethnic group, Chinese heritage families in England. The parents in my study are all first-generation immigrants to the UK, and all the children were born and raised in England. For the definition of Chinese heritage families in my study, I include interlingual families with only one Chinese parent and the immigrant families with both Chinese parents. All Chinese parents who volunteered for the study were Mandarin speakers. For this reason, when referring to language, Mandarin and Chinese are used interchangeably in this thesis, while acknowledging the many other Chinese languages and dialects in existence.

Next, scholars pointed out that limited research has been done to understand varied modes of children's language practices; as digital communication practices involving the HL are more frequent and important in heritage families, how HL is practised in digital activities, with or without interpersonal communication, should be examined (Bose et al., 2023). In my study, the diverse touchscreen activities that may create a space for HL communication for a bilingual child are explored, and how languages are practised through parent-child interactions or communications between the touchscreen and the child are also investigated.

Then, when specifically looking into the studies on HL maintenance within Chinese communities, while many studies involved preteens (Huang & Liao, 2024; Shen & Jiang, 2021) and children within a wide age range (Curdt-Christiansen & Iwaniec, 2023; Tang & Zheng, 2023), limited research has been done with younger children and a narrower age group. The age group of participating children in my study is carefully decided. While choosing a narrow age group from 3 to 7 years old, this age group still covers a range of different developmental stages of children.

Last but not least, while various sociocultural factors can influence children's bilingual language development (Genesee, 2023), many studies have emphasised the crucial role of parents in facilitating their digital literacy practices within bilingual or heritage families (Al Salmi & Gelir, 2024; Haoning Mah et al., 2021; Little, 2019; Ozturk & Ohi, 2022; H. Sun et al., 2022; Yoon, 2023). As studies pointed out that some parents may lack the digital skills or awareness to facilitate their children's bilingual literacy with touchscreens (Little, 2019), parents may need support to gain more knowledge on facilitating their children's digital literacy practices (Hao, 2023; Ozturk & Ohi, 2022). In my study, I notice some realistic challenges that the parents meet in fostering bilingual

touchscreen literacy practices, and related implications are discussed in the conclusion.

1.4 Research objectives and questions

Bringing my research interest, the research context, and potential research gaps together, my study aims are illustrated as follows. First, I aimed to investigate six Chinese-English bilinguals' family language choices and understand their bilingual digital literacy practices during their engagements with touchscreen apps and devices at home. Second, I focused on understanding the parental role in related activities.

Based on my research aims, the research questions are designed as follows:
1. What is the general pattern of a young bilingual/multilingual child's home language choices?
2. How does a young bilingual/multilingual child develop their digital literacy through touchscreen activities?
3. What is the parental role in facilitating the child's bilingual/multilingual language development through touchscreen activities?

In my study, language and literacy development includes all intentional and incidental, formal and informal language practices of these bilingual children over time.

1.5 Methodological design

For the methodological design, I combined both the digital ethnography approach (Cocq & Liliequist, 2024; Pink et al., 2015) and the case study approach (Baxter & Jack, 2015; Yin, 2009) effectively for my study design. Following the case study approach, I chose Bronfenbrenner's bioecological model (2006) as the theoretical framework to shape and support my specific study methods and structure my findings. Applying the digital ethnographic elements facilitates the exploration of participants' family life in more depth, especially with migrant families (Winarnita, 2019) and within digital contexts (Cocq & Liliequist, 2024). Due to the influence of the COVID-19 pandemic, with the enlarged definition of 'fieldsite' that includes online spaces and virtual spots (Chambers, 2020), the digital ethnography approach guided my fieldwork as it is a practical and flexible way to conduct research during the pandemic (Foley, 2021; Góralska, 2020). The participants in my study were all Chinese heritage families, with first-generation immigrant Chinese parents, and children who were born and raised in England (aged from 3 to 7).

After receiving the ethical approval letter, I successfully recruited six families and gained their consent; data collection was then conducted. With each family, I held three family interviews (Little, 2024) and a language portrait (LP) activity (Busch, 2018) that visualised the languages and identity of a child through painting a body silhouette image with different colours to represent languages. Two sets of parent-recorded videos (Wilkinson et al., 2020) on the child's touchscreen use were gained, and three evolving mediagrams (Lexander & Androutsopoulos, 2021) that illustrated the changes in the child's multiple language uses, touchscreen activities, and use of apps were drawn. Thematic analysis (Braun & Clarke, 2006) and observational content analysis (Drisko & Maschi, 2015) were applied during data analysis.

During the data analysis, specific language choices in each family were discussed through the lens of FLP (Curdt-Christiansen, 2009), and each bilingual/multilingual child's home touchscreen activities and their digital literacy practices were demonstrated and analysed in detail. Parents' attitudes and beliefs, parental mediation (Zaman et al., 2016) strategies, and parent-child interactions related to their bilingual children's touchscreen activities were carefully examined in my study. Meanwhile,

children's agency (Shen & Jiang, 2023) in forming their language choices was also stressed.

1.6 Main contribution to knowledge

My study contributes to knowledge in empirical, methodological, and theoretical aspects. First, by focusing on the touchscreen and language experiences within the Chinese heritage families in England and with a narrow age group of children, my study contributed to adding more in-depth research findings within this specific ethnic group in the UK. My research findings could greatly add knowledge to understand children's touchscreen engagement within heritage language backgrounds. Methodological-wise, I discussed the potential benefits of involving language portrait activity (Busch, 2018) and co-viewing of parent-recorded videos in the interviews to facilitate the participants' reflections related to the research topics. I also combined case study and digital ethnography together to better explore the complexity of children's language and digital experiences. This innovative methodological approach enhances the credibility of my study, and I hope it will inspire further research in this field. For the theoretical contribution, I also explored the applicability of Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006) in understanding children's bilingual development with touchscreen activities. I discussed how different factors and systems influence a bilingual child's language development while bearing the digital elements (Johnson & Puplampu, 2008) in mind.

1.7 Thesis structure

After a general overview of my study background and design, the following chapters of my thesis are structured as follows. First, Chapter 2 is the literature review on research topics related to my study. A body of literature on children's touchscreen use, children's agency, digital literacy, bilingualism, the role of home and parents, the theoretical underpinnings of my study, and research gaps are discussed in this chapter. In Chapter 3, the specific methodological designs of my study are presented, including the research aims, methodological drives, recruitment, data collection, transcription, data analysis methods, and a section on the researcher's reflexivity. After this, the six individual case studies are analysed with plenty of examples extracted from the data; each family's FLPs, LP activity, and three evolving mediagrams were analysed with other collected data in Chapter 4. In Chapter 5, a cross-case analysis is written to compare the similarities and differences of each case, and then additional methodological findings and the applicability of Bronfenbrenner's bioecological model are explored. In Chapter 6, a conclusion of the thesis is made, which includes a summary of the main findings and limitations of my research, contribution to knowledge, and implications for parents, researchers, and practitioners.

Chapter 2. Literature Review

In this literature review, I examined a body of literature to gain a better understanding of the research areas that are related to my study. First, children's touchscreen adoption at home in global and UK contexts is examined. Second, as my study only involves bilingual families within a specific ethnic group, the literature on bilingualism, especially research on heritage language maintenance, family language policy, translanguaging practices, and within Chinese heritage families, is investigated. Next, the vital role of home and parents in children's adoption of digital devices and their digital literacy practices are discussed. Then, more studies on children's digital literacy practices are reviewed, and some specifically focus on bilingual children. In the summary of this literature review, potential research gaps and how my study addresses them are discussed.

2.1 Children's touchscreen adoption at home

2.1.1 Children's touchscreen adoption at home

In the current era, digital media and devices are commonly accessed in most children's daily lives (Chen et al., 2020; Day et al., 2024; Scott, 2022). As a common type of digital technology, touchscreen devices have been regularly integrated into children's homes, and gradually became an inseparable part of their family life (Choi et al., 2021; Chowsomchat et al., 2023). Based on the statistics provided by The Common Sense Census: Media Use by Kids Age Zero to Eight in 2020, about 97% of children between 0 and 8 years old in the US had access to a smartphone, while 75% of them were able to use a touchscreen at home (Rideout & Robb, 2020). Also, almost half (48%) of the children owned a mobile device, while 46% of the 2-4-year-olds had their own touchscreen (Rideout & Robb, 2020).

Similar statistics are found in the UK. According to the report from Ofcom (2022) on children's media use and parental attitudes in the UK in 2021, 78% of the 3-4-year-old children used a touchscreen to go online, and 39% of them used a mobile phone to do so (Ofcom, 2022). The report also pointed out an increasing use of touchscreens for 5-7-year-olds: 28% of this age group owned a mobile phone, half of them used a phone to go online, and 83% of them also used a touchscreen to surf the internet (Ofcom, 2022). In addition, according to the latest report from Ofcom (2024) that explored the media use and attitudes of children and parents in the UK in 2023, 96% of the children aged from 5 to 7 years old went online, and 26% of them owned personal mobile phones (Ofcom, 2024). Compared to the statistics carried out by Ofcom in 2017, touchscreen adoption among children increased a lot. For example, only 1% of the 3-4-year-olds had their own mobile phone in 2016 (Ofcom, 2017), while 17% of them had their own mobile devices in 2021 (Ofcom, 2022). Similarly, for the 5-7-year-old children, 5% of them owned a mobile phone in 2016 (Ofcom, 2017), and the percentage increased to 26% in 2023 (Ofcom, 2024).

Moreover, the influence of COVID-19 on children's home touchscreen use should not be underestimated (Day et al., 2024). In a recent narrative review on children's home digital literacy practices, the use of touchscreen devices such as tablets and smartphones in the home environment significantly increased between 2015 and 2021, and specifically due to the pandemic, the use of these digital technologies became an integral component of people's lives (Soyoof et al., 2024). Similarly, in a study exploring the digital media use in 141 Singaporean bilingual families (children aged 3-6) (Sun et al., 2022), it was found that the quantity and quality of bilingual children's use of touchscreen tablets and smartphones before and since the pandemic differed greatly. For example, a great increase in the touchscreen time that children spent on engaging with English digital resources rather than their home language was found

(Sun et al., 2022).

Based on the above statistics and studies, the adoption of touchscreen and mobile devices seems to be prevalent and an inseparable part of many children's lives. However, the potential digital divide in the UK should be kept in mind before making an affirmative conclusion about the universal access of touchscreen devices in children's lives. In the latest Ofcom report, 34% of parents of school-aged children reported that their children did not have continuous access to a digital device that could meet their online school needs (e.g., finish online schoolwork) at home (Ofcom, 2024). Therefore, it is not reasonable to analyse children's touchscreen adoptions in a large and general sense. It should be recognised that their use of touchscreens can be varied in different family and social contexts. In my study, I focus only on the home touchscreen adoptions of six 3-7-year-old children from Chinese-English backgrounds in England, and I follow a multi-case study approach (Gustafsson, 2017) to respect the diverse contexts in different families.

2.1.2 Reasons for the touchscreen's popularity among children

Although it is not appropriate to explore children's touchscreen adoption in a general sense, the above statistics illustrate the prevalence and significance of touchscreen use in children's lives. Touchscreen devices have various new features compared to traditional screens (e.g., televisions), which may explain a bit about its popularity in children's lives. First, a touchscreen is portable and convenient to carry (Pham & Lim, 2019). Children can engage with activities on touchscreens in multiple spaces, for instance, moving from the living room to their bedroom (Poveda et al., 2020). Second, tablet devices (e.g., iPad) are typically designed with larger screens, enabling the use of more interactive educational apps, and larger touchscreens often encourage collaborative use, allowing parents or caregivers to engage with children and promote co-use experiences (Chowsomchat et al., 2023). Third, touchscreens are always interactive in nature (Pham & Lim, 2019), and with some multimodal and multimedia designs, some apps (e.g., e-books) can boost children's interests in app contents and facilitate their digital literacy practices (Al Salmi & Gelir, 2024; Mifsud et al., 2021). More research related to children's touchscreen use and digital literacy will be discussed in section 2.5.

Another reason for the popularity could be the growth of touchscreen apps that are designed and marketed towards children (Colliver et al., 2020; Livingstone et al., 2019). Many of these apps aim to provide dynamic and interesting learning experiences for children; some free apps can pose greater risks for children to access and use than purchased apps, as they may be repeatedly exposed to in-app commercials (Livingstone et al., 2019).

When defining touchscreens in my study, I try to include all touchscreen devices with interactive functions, which include mobile phones, tablets, and other touchscreen devices (e.g., touchscreen watch). Touchscreens in my study are not restricted to certain brands but all touchscreen devices that a child has access to at home.

2.1.3 Children's use of touchscreen

Many studies have identified that touchscreen devices had been frequently integrated to children's family life (Harrison & McTavish, 2018; Kumpulainen & Gillen, 2019; Marsh et al., 2018; Poveda et al., 2020), and many children started using touchscreen technologies at a very young age (Chowsomchat et al., 2023; Dardanou et al., 2020; Liszkai-Peres et al., 2024; Pham & Lim, 2019).

In some studies, the frequency and length of children's touchscreen use were investigated. For instance, according to a study on 0-5-year-old children's app use in the UK, children used touchscreens for an average of 1 hour and 19 minutes during an ordinary weekday and 1 hour and 28 minutes during a day on the weekend (Marsh et al., 2018). During the pandemic , policies and laws on school closures, social distancing, and working from home had been released (Nagata et al., 2020). Considering this, a sharp rise in the amount of time children spent using touchscreens and screens at home was captured (Nagata et al., 2020; Vanderloo et al., 2020; Wiederhold, 2020). Besides, the three years of COVID-19 pandemic had a significant influence on children's schooling, requiring many of them to complete their coursework via online school services at home (Ofcom, 2022). Increasing touchscreen use was important to address a variety of demands, including those related to education (e.g., attending online classes), sociability (e.g., making video calls to distant families), entertainment of children, and working parents' time management (Vanderloo et al., 2020).

Apart from length and frequency of touchscreen use, research has discovered that children engage in a variety of touchscreen activities and use a wide range of touchscreen apps. For instance, *YouTube* was the most popular app for children under five in Marsh and her colleagues' (2018) study, and the children frequently used *Talking Tom* and *CBeebies* as well (Marsh et al., 2018). Besides, children can engage in a variety of touchscreen-based activities with the help of different apps. In a study investigating 552 preschool children's (0-3) home touchscreen adoption in Norway, Portugal, and Japan (Dardanou et al., 2020), with slight differences among these countries, children's favourite touchscreen activities were diverse, such as watching videos/cartoons, using educational apps, using *Skype*, and viewing photos/videos. Within the UK context, according to the latest report on children's media use (Ofcom, 2024), while *YouTube* remained the most popular app among all age groups, 5-7-year-olds demonstrated an increase in using apps to do the following activities, compared to last year: sending messages or making video/voice calls (from 59% to 65%), watching live streaming apps/websites (39% to 50%), playing social media apps (30% to 38%), and playing online games (34% to 41%).

The research discussed in this section shows that children's touchscreen activities and app choices are complex and diverse. As children's developmental stages differ widely in early years (Marsh et al., 2018; Nuñez, 2019), studies relating to children's touchscreen activities and use of apps should be conducted within a particular or narrow age group. Besides, some studies (Al Salmi & Gelir, 2024; Fu et al., 2024) conducted after the pandemic found that the length and frequency of children's screen time were still restricted because of parental concerns and mediations (more about this will be discussed in section 2.3). In my study design, instead of focusing on the length and frequency of children's home touchscreen use, I put more stress on understanding their use of specific apps and touchscreen activities and related language experiences.

2.1.4 Children's agency and interactive media

After discussing the popularity and frequency of children's home touchscreen activities in the above sections (Chowsomchat et al., 2023; Dardanou et al., 2020; Liszkai-Peres et al., 2024), it is important to investigate the role of children's agency during their touchscreen use. According to the vital principle of the United Nations Convention on the Rights of the Child (UNCRC), it is necessary to value children's rights in all circumstances (United Nations, 1989). Within the digital context, children's agency, which is a significant part of children's rights, plays an important role in their interactions with touchscreens (Kucirkova, 2019). In the following subsections, I will

first examine the concept of children's agency in a nuanced way; then, I will discuss the role of children's agency in digital use.

2.1.4.1 Definition of children's agency

Agency can be generally defined as the ability to act with intention (Schlosser, 2015). Intentionality, which is a central element of agency, is related to both the internal beliefs and motivations of a person and the external sociocultural environments where intentions are formed and expressed (Schlosser, 2015; Varpanen, 2019). Following the two dimensions of intentionality, when understanding agency, there is a tension between viewing agency as the ability that a person equips or understanding it as being fostered within relational and social interactions (Abebe, 2019; Varpanen, 2019).

In terms of children's agency, it is a crucial concept and has been studied for many years in early childhood education research (Varpanen, 2019). Children are viewed as independent decision-makers in their activities, and their agency is influenced by surrounding sociocultural environments, their familiarity with the environments, and levels of responsibility (Petersen, 2015). As discussed in the above paragraph, the relationships between the social/structural aspect and children's personal/subjective aspect of agency should be investigated (Abebe, 2019; Varpanen, 2019). I will trace back to earlier interpretations related to agency in childhood studies to better understand how the concept of children's agency has evolved. Since theory functions as a broader framework of meanings that researchers use to conceptualise specific concepts, children's agency, as a key concept of education studies, should be suited and studied within a theoretical framework (Biesta et al., 2014; Varpanen, 2019). I will examine and reflect on children's agency within theory.

During earlier research, while some theories related to children's development emphasise the importance of external environments in shaping a child's development, the agency of children is less focused (Haring et al., 2019). For example, according to Vygotsky's sociocultural theory, a child's development comes from interactions with more skilled people around them and is closely related to the surrounding social and cultural environments (Vygotsky, 1978). Similarly, Bronfenbrenner's (1979) ecological model has been criticised for viewing children as passive receivers of environmental influences and not recognising the active role of a person's characteristics and agency (see details in section 2.4.1). Reflecting on that, Bronfenbrenner later expanded his original ecological theory into the bioecological model (Bronfenbrenner & Morris, 2006), in which the active role of children is emphasised as a key element to influence their development (see details in section 2.4.2.6).

In the late 1990s, there was a shift in the notion of children's agency in childhood studies (Haring et al., 2019; Varpanen, 2019). For instance, the new sociology of childhood research paradigm that appeared in the 1990s (Oswell, 2013) views children as active social agents and believes in the importance of a child's subjectivity in changing and influencing their environments. At this stage, children are always viewed as social actors who can actively influence their lives rather than passively receiving other people's instructions and social rules (Abebe, 2019). However, these interpretations or models of children's agency as active social actors can be too simplistic (Hammersley, 2017), as children's autonomy and control over the environment tend to be overemphasised, and the influence of specific contexts is less considered (Abebe, 2019). In addition, from the sociocultural theoretical perspective, while scholars still highlight the importance of the interactions with sociocultural contexts in shaping children's agency, some later theories begin to bring in the notion of children's sense of agency to respond to the critiques of traditional sociocultural theories and expand upon them (Varpanen, 2019). For example, the framework of the

six modalities of agency emphasises children's experiences and beliefs in influencing their agency and decision-making in various sociocultural contexts (Hilppö et al., 2016; Varpanen, 2019).

Based on the above discussion, children should not be viewed as passive recipients of social and relational instructions. The role of children's agency should also not be exaggerated, and the influence of sociocultural contexts in shaping children's agency should not be overlooked. In other words, children can be both dependent and independent, their agency is enacted in different ways through interactions with different surroundings and people (Abebe, 2019). For example, children's agency may be influenced by parental control and expectations in the home environment; a child may have limited space to demonstrate their agency during touchscreen activities if their parents strictly mediated their touchscreen use. From my point of view, children's agency needs to be studied within specific contexts and considered from two aspects. On the one hand, to what extent children are able to control their environment; on the other hand, how children's agency is enacted and practised in this environment.

In my thesis, children's agency refers to children's capacity to actively and intentionally act in specific situations, especially within their home environments. Both the influences of sociocultural factors (e.g., parents' beliefs and mediation) and children's enacted agency are considered and discussed when studying their specific touchscreen and language activities. In the following section, I will focus on examining literature regarding children's agency within the touchscreen environment. Apart from children's touchscreen engagement, my study also investigated the language choices of these children from Chinese heritage backgrounds. Therefore, I will also discuss the active role of children's agency in their language choices in sections 2.2.3 and 2.2.4.

2.1.4.2 Children's agency, digital design and development

After understanding the vital role of children's agency within the multimedia environment on children's learning, how to integrate children's agency into digital design and how to facilitate children's digital experiences while respecting their rights (i.e., free play) should be considered by game designers (Colvert et al., 2024). In this section, I want to discuss more about the relationships between children's agency and digital design and how children's agency can be integrated into digital design.

In the real world, integrating children's agency into digital design involves several stakeholders, such as governments and companies; it is a complicated and challenging task (Colvert et al., 2024). Game developers may need to consider conflicting factors that influence their digital design and business models (Pothong et al., 2024). For example, while several story-making apps developed by commercial companies often use pre-designed story templates and let children complete or add details to these pre-set contents, apps developed by child-centred organisations are usually more open-ended and give children more freedom to engage (Kucirkova, 2019). Kucirkova (2019) argues that there is a difference between automatic personalisation and agentic personalisation when considering the position of children's agency in digital design. The former integrates children's agency through automatic algorithms that can adjust app contents based on a child's data, while the latter emphasises children's intention and volition when engaging with apps (especially story-making apps) (Kucirkova, 2019). When embedding children's agency into app design in an authentic way, children should be viewed as active agents who shape their own digital experiences, rather than passive receivers of algorithmic interventions. Digital design should reduce characteristics that hinder children's free play (e.g., in-app advertisement) and add elements that can enhance it (e.g., inclusive environments) (Colvert et al., 2024).

In Kucirkova's 5As model of digital personalisation in story-making apps (Kucirkova, 2017), the app design becomes more personalised when authorship, autonomy, authenticity, aesthetics, and attachment are valued. Among all the five factors, authorship and autonomy are the two main factors that make the design of the Our Story (OS) app unique by putting children in the centre (Kucirkova, 2019). While authorship focuses on how multimedia elements of an app interface can support children's volition and share their own opinions, autonomy means giving children more control over the design process and encouraging their independent use of apps (Kucirkova, 2019). For example, a child can combine text, sounds, and videos in the OS app to create their own story and express ideas (authorship), and the child can edit and rearrange these multimedia elements independently and change their original story (autonomy). In particular, autonomy gives children freedom to choose, amend, and change the design process and final product; during this process, children's agency is highly respected and engaged (Kucirkova, 2019).

Similarly, after listening to the voices of different stakeholders (children, parents, developers, scholars of children's rights), Colvert and her colleagues (2024) developed Playful by Design principles to provide a starting point for app designers and developers to better integrate children's agency and rights into their products. These principles are: be welcoming, enhance imagination, enable open-ended play, adopt ethical commercial exploitation, ensure safety, allow for experimentation, and be age appropriate (Colvert et al., 2024). It should be acknowledged that these principles should be applied within specific sociocultural environments in a practical and flexible way (Colvert et al., 2024).

Moreover, children's agency not only plays an important role at the design stage, it also influences a child's actual touchscreen engagement and development within specific contexts. Research has found that children's agency plays a vital role in facilitating their learning and development during their engagements with touchscreens (Kucirkova, 2019; Peebles et al., 2018; Russo-Johnson et al., 2017). For example, in a study involving 77 2-5-year-olds in a southeastern U.S. city (Russo-Johnson et al., 2017), children's self-regulation during their touchscreen interactions was investigated. The study findings indicated that children's agency, especially their capacity to manage their tapping behaviours when playing a word learning app on a touchscreen, influenced their learning results; children who could control their impulses to tap performed better during this activity, and children who had low self-regulation tended to be distracted from the learning process (Russo-Johnson et al., 2017). In another study conducted with 97 3-5-year-old children in the Midwest U.S. (Peebles et al., 2018), these children were divided into five controlled groups, and their comprehension outcomes on moral topics through watching an educational cartoon episode were examined. In this study, research findings indicated that children's agency supports their learning process, as they controlled their speed and pace of watching the video and through interactions; children achieved better learning outcomes when they operated the device independently and engaged with touchscreens that gave them immediate responses and bidirectional interactions in the Q&A design (Peebles et al., 2018).

As mentioned in section 2.1.4.1, children's agency should be considered from two sides: to what extent do children have control over their environment and how their agency can be enacted within the context. The features of touchscreen environments provide children opportunities to practise their agency. For instance, as mentioned in the above studies, children's agency is demonstrated through their independent operation and control of touchscreen devices, the turn-taking conversations, and the timely response from touchscreen apps, which facilitates their learning and

development. In addition, in Bronfenbrenner's (2006) bioecological model of human development, compared to interactions with people, a child may act more actively during their independent interactions with objects (Bronfenbrenner & Morris, 2006). For example, a child may be curious and motivated to engage with touchscreens independently and develop more digital skills using their equipped knowledge and experience (see details in section 2.4.2.6).

To briefly summarise, children's agency is vital for their learning and development in the digital world. By carefully considering and integrating children's agency into digital design, children can practise their agency in a safe and inclusive digital environment (Colvert et al., 2024), which can support their independent digital play and further development. Meanwhile, it is also important to examine how children's agency is enacted through their engagement with activities in specific contexts.

2.2 Bilingualism, heritage language, and translanguaging

Apart from understanding how children engage with touchscreen activities at home, another vital element of my study is to explore Chinese heritage children's experiences of practising and developing bilingualism.

2.2.1 Bilingualism and biliteracy

The definition of bilingualism has evolved gradually. In the 1930s, being fully fluent in both languages was the ideal definition of bilingualism (Marian & Hayakawa, 2021). More recently, bilinguals could refer to people who use two languages (or more) with a certain level of proficiency depending on the situation (Bialystok, 2001). Additionally, according to some scholars, bilingualism cannot be limited to a single definition because it is a dynamic and individual experience that differs depending on the sociolinguistic context (Bialystok, 2001; Marian & Hayakawa, 2021; Surrain & Luk, 2019). Bilingual people acquire their languages from different backgrounds for varied needs, which can form various individual language experiences and forge their sociocultural identities, neurological functions, and cognition (Marian & Hayakawa, 2021). Since bilingual experiences are linked to a variety of aspects, they should be considered more as a continuum than just a linguistic division (Luk & Bialystok, 2013). The concept of a continuum emphasises how continuous and vibrant multilingual activities are (Surrain & Luk, 2019). Studies point out that as bilingual children are exposed to different languages since they are born, they are sensitive to the sociocultural linguistic differences of languages, and the multiple language exposure at a young age may affect their own language preferences (Genesee, 2023; Uttley et al., 2013). There are some sociocultural factors that influence a young child's development of bilingualism, such as the community language environment, parental language choices, and the social status of languages (Genesee, 2023). Therefore, I think bilingualism should be researched in specific situations, considering the influences among several variables, such as sociocultural factors.

Moreover, within all the sociocultural factors that affect children's bilingual language experiences, the starting of school and formal education may shift children's attention from home literacy to formal school literacy (Curdt-Christiansen & Morgia, 2018; Stewart, 2017). The beginning of school life means that the children need to reach a series of learning aims set by schools and use the school language (mostly English); therefore, they may pay more attention to English instead of their home languages, regardless of the positive affect of home literacies on their motivation to read, sense of self and identity (Little, 2019; Stewart, 2017). As home literacy experience plays a vital part in children's multiple developments and sometimes is less focused compared to school literacy, I put more stress on understanding the young bilinguals' home literacies with the use of touchscreens instead of studying their school literacy

practices. Besides, the age range of participants in my study is from 3 to 7 years old, which covers preschool to the beginning of junior school in the UK, making the age group diverse.

2.2.2 Heritage language (HL) maintenance

The types of bilingual/multilingual speakers can be varied. Being a heritage language (HL) speaker means that a person is regularly exposed to a society's non-dominant language at home or in community environments from a young age (Rothman, 2007). As the formal language is mostly English in most schools and public situations in England, these bilingual/multilingual participants in my study should be regarded as HL speakers rather than minority language speakers who live in a society with several formal languages. HLs are always picked up through everyday interactions and household literacy activities (Kupisch & Rothman, 2018). To strengthen family ties and promote self-recognition of one's culture and identity, heritage language families place a high priority on maintaining their native tongue (Little, 2019; Wang, 2023). For all the children in my study, they have been exposed to Chinese since birth. As English is the dominant language used in England, Chinese is identified as HL.

Similar to the studies on bilingualism discussed in the above section, for heritage-language families, many sociocultural factors could influence children's HL development (Park et al., 2012). In a study on ten Russian-speaking immigrant families in Spain (Ivanova, 2019), the language attitudes and choices of the first-generation, HL transmission strategies to help their children develop their HL are all vital for facilitating the second-generation's HL development. For the families with positive feelings towards their HL, strategies such as using the HL in their daily communication and some targeted language activities were used in these families, and these efforts were crucial for facilitating the children's development of fluent HL (Ivanova, 2019). Similarly, in a longitudinal study involving 288 Spanish-speaking Latino children in the Northeast United States (Collins & Toppelberg, 2021), how their home background, family language choices, and their language use in schools could affect their bilingual development were examined. As Spanish was not the dominant language in this societal context, children's Spanish capacity was mainly related to their home language environment, the parents' language use at home and their family literacy practices (Collins & Toppelberg, 2021).

As seen from the above studies, a supportive family climate (Park et al., 2012) is vital for a child's HL development. However, when some parents try to create a good HL language environment and engage in HL activities with their children, they may encounter realistic difficulties. In a study conducted with 68 Chinese immigrant families who had preschool-aged children in the United States, Park and her colleagues (2012) found that there were several challenges that may lead to HL loss in these families. In this study, the parents reported a primary challenge was the lack of resources to support their children's HL development; with limited HL resources and exposure of HL outside the home environment, children did not have enough chances to practise their HL and may primarily learn much knowledge in the major language (Park et al., 2012).

Similar to the HL loss discussed in the above study, the term HL shift (Fishman, 2001) is used to describe the phenomenon that a community gradually changes their language use from HL to a more societal dominant language, especially for minority or immigrant families and communities (Valdés, 2017). The HL shift can be hard to reverse due to many sociocultural pressures, such as the necessary use of dominant language in their public life and the younger generation's education (Fishman, 2001). Fishman (2001) emphasised the importance of maintaining a dynamic and intensive

language environment where HL should be used and valued in various social contexts, such as facilitating the use of HL in family and community environments and in school education. However, when embedding heritage language education (HLE) to foster the younger generation's Hl maintenance, the effectiveness of HLE programs that teach and test language based on traditional curriculums in formal school settings should be discussed (Valdés, 2017). It is argued that the current HLE practised in formal education itself may lack the authenticity compared to HL practised in real-life situations; more creative and community-based methods should be used in HLE to acknowledge the complexity of HL language experiences and identities (Valdés, 2017).

2.2.3 Family language policy (FLP)

As discussed in the above section, for HL-speaking children, family attitudes and involvements are crucial for their HL development, especially when limited resources are available to support HL maintenance (Fishman, 2001; Smith & Li, 2022). When investigating HL maintenance within the home environment, family language policy (FLP) is a frequently-used lens (Bose et al., 2023; Y. Wang, 2023). FLP is crucial for facilitating children's HL development and helping parents to manage and participate in language-related activities with their children (Liao & Huang, 2020). The definition of FLP adapted in this article is FLP as "explicit and overt as well as implicit and covert language planning by family members in relation to language choice and literacy practices within home domains and among family members (Curdt-Christiansen, 2018, p. 420)." FLPs play a fundamental role in helping children maintain their HL and for parents to manage and engage in language-related activities with their children (Liao & Huang, 2020). The sub-discipline of FLP has been developed to examine how languages are explicitly or implicitly organised, negotiated, and practised through family language practices, with the goal of transmitting HLs (L. Wang & Hamid, 2022).

Parent's role and children's agency in language choices

In current FLP studies, not only the strategies that parents use to facilitate their children's bilingual development, especially HL development, are explored; children's perspectives and their role in forming FLP are also stressed (Little, 2023; Roberts, 2023; Wilson, 2020). While parents play a vital role in creating their FLP, children should not be viewed as passive receivers of parental language management strategies (Wilson, 2020). While parents demonstrate their agency in planning and influencing their children's HL use at home based on their beliefs about HL maintenance, children's agency also plays an active role in responding and adjusting to parental language management strategies and actual language practices (Little, 2023; Shen & Jiang, 2023). It is vital to consider both parent's role and children's agency in developing and practising their FLP (Shen & Jiang, 2023).

In a study exploring three multilingual families' (Chinese, Malay, and Indian ethnicity individually) FLP in Singapore (Curdt-Christiansen, 2016), it was found that the parents and children held different views towards the language choices of both languages and sometimes could lead to the co-existence of some conflicting FLP strategies within a family. For example, when parents believed that it was vital to use their HL as this was part of their cultural identity, the children in the same household preferred to use English as it was the societal dominant language for achieving educational and other goals (Curdt-Christiansen, 2016). In another study conducted with French-English bilingual children in the UK (Wilson, 2020), the findings suggest that children and parents may have different opinions on the same FLP. Children may feel frustrated or anxious if their parents force them to practise their HL strictly, and they may form more positive attitudes towards their HL when experiencing a more relaxing FLP (Roberts, 2023; Wilson, 2020). In another study exploring over 500 HL-speaking children's (aged 10–12) emotional language preferences in a Dutch-speaking city in Belgium (Dekeyser

& Agirdag, 2021), it was found that the children's HL language practices were closely related to their emotional preferences for languages. For children who were fluent HL speakers, they tended to express their emotions in their HL, no matter how well they spoke the major language, Dutch (Dekeyser & Agirdag, 2021). Therefore, when investigating bilingual children's FLPs, apart from admitting the significant role of parents in creating and facilitating children's HL development, children's agency and their voices on FLPs and HL maintenance should also be valued and studied (Shen & Jiang, 2023; Wilson, 2020).

However, identifying the importance of children's agency in developing FLP does not mean exaggerating children's ability to decide their language choices. FLP and family language choices are influenced by multiple factors and varied across different family experiences (Wilson, 2020). Sociocultural factors such as the COVID-19 pandemic, globalisation and immigration, communication through digital media, are all influential in developing a FLP (Bose et al., 2023, 2024). For example, in a study exploring FLPs of 2,971 English-Chinese and 780 English-Malay children who aged from 9 to 11 years old in Singapore (Sun et al., 2023), while acknowledging children's active role in influencing their FLP, their language choices were restricted by the national language policy that prioritised English. In a recent systematic review of FLP studies in migrant families (Bose et al., 2023), it is argued that further FLP research should demonstrate awareness of different modes of language practices; not only the traditional HL language practices but also the digital HL practices, especially the HL digital communication practices, should be investigated. In my study, the young bilinguals' family language choices will be discussed in Chapter 4 and Chapter 5.

2.2.4 Family language policies (FLPs) within Chinese-heritage families

After reviewing the literature on bilingualism, heritage language maintenance, and FLP in general, and as my study aims to explore the language choices in Chinese heritage families, more studies conducted within this specific ethnic group will be discussed here. In my study, the definition of Chinese heritage families includes immigrant families with both parents from China and interlingual families with only one parent from Chinese heritage and one from another heritage. For the other parent of the interlingual families in my study, their heritage languages can be the societal major language (English) and other minor languages except Chinese (Bahasa Indonesia).

The influence of parents' language ideologies on children's HL maintenance and bilingualism development is significant (Curdt-Christiansen, 2009). Studies have identified the positive attitudes of parents towards children's Chinese maintenance in many Chinese heritage families (Chen et al., 2021; Liang & Shin, 2021; Shen & Jiang, 2021; Wang, 2023). The reasons behind the positive attitudes towards Chinese maintenance are often related to the benefits of maintaining this language. From a parental perspective, maintaining Chinese represents a value of their heritage culture and identity (Liang & Shin, 2021; Shen & Jiang, 2021; Wang, 2023); Chinese is a necessary and vital tool to foster tight family bonds and communication (Liang & Shin, 2021; Wang, 2023); and developing another language could benefit their children's cognitive development (Huang & Liao, 2024) and future careers (Huang & Liao, 2024; Liang & Shin, 2021; Shen & Jiang, 2021; Wang, 2023).

From these studies, some specific strategies are often mentioned to facilitate children's Chinese maintenance and development. For example, in a study investigating three Chinese immigrant families in the US (children aged from 5th grade to 10th grade), within their home environment (Liang & Shin, 2021), Chinese was frequently used in daily parent-child communications; parents mentioned that they would use Chinese resources at home, such as Chinese storybooks and videos, and for two children in

this study, they also used social media and technologies to contact remote family members in Chinese. Stepping out of the home environment, while parents reported limited available Chinese resources, many of them sent their children to community Chinese school and believed it was a crucial way to facilitate children's Chinese literacy skills (Huang & Liao, 2024; Liang & Shin, 2021; Shen & Jiang, 2021; Wang, 2023). Apart from these strategies, in a study with thirty Chinese-Australian children who aged from 10 to 11 (Shen & Jiang, 2021), some parents also mentioned that they made regular trips to China to create a language environment and facilitate their children's Chinese development.

However, parental language ideologies within Chinese heritage families were not always positive, studies have also identified complicated and even contradictory language ideologies within one family (Huang & Liao, 2024; Tang & Zheng, 2023). In a study investigating the Chinese maintenance of four interlingual families with children aged from 10 to 12 years old in Australia (Huang & Liao, 2024), the Chinese parent in each family demonstrated strong beliefs on the benefits of maintaining Chinese, the non-Chinese parents also demonstrated positive attitudes towards their children's Chinese maintenance, but they held different views on to what extent Chinese should be maintained. A unique challenge for Chinese maintenance in these interlingual families is that their FLPs are affected by the need to keep harmonious family relationships (Huang & Liao, 2024). For example, one Chinese mother in this study mentioned that they spoke English only when the father was at home to not exclude him from the parent-child communications (Huang & Liao, 2024).

Besides, in another study involving six Chinese immigrant families in Boston (children aged from 5 to 16 years old) (Tang & Zheng, 2023), parents needed to balance multiple and sometimes contradictory language ideologies at home. For example, a mother of a five-year-old child mentioned that, while she viewed Chinese as a resource to foster deeper family bonds, she also believed that maintaining Chinese was a problem as it could influence her child's mainstream educational performances, and she wanted her child to speak English natively (Tang & Zheng, 2023). Based on the mother's contradictory language ideologies, in this family, the mother spoke mostly Chinese to her child, and the child replied in English only at home (Tang & Zheng, 2023).

Children's agency in language choices in Chinese heritage families

While acknowledging the vital role of parental language ideologies on maintaining HL and bilingualism development (Huang & Liao, 2024), children's agency in their FLP is also crucial (Shen & Jiang, 2023). Compared to parents, children may demonstrate varied language attitudes and agency in influencing and shaping their FLP. In a study conducted with three Chinese heritage families in Australia (the bilingual children were all Year 5 students) (Shen & Jiang, 2023), both parent's and children's agencies played significant roles in influencing their HL practices. However, children's agency varied across the three case studies; one boy demonstrated strong agency in maintaining his HL, a girl showed her resistance to speaking Chinese and different agency in FLP compared to her parents, and the other girl did not show much agency in developing Chinese due to a lack of support and HL exposure (Shen & Jiang, 2023).

Meanwhile, although for many parents, maintaining their heritage culture and identity is a critical part of their language beliefs (Liang & Shin, 2021; Shen & Jiang, 2021; Wang, 2023), for their children, happiness and sense of achievement can be factors that mostly influence their motivations of developing Chinese (Huang & Liao, 2024). With sufficient supports from family and community, children may be more motivated to develop their Chinese skills in a voluntary and active way instead of being forced by the parents (Shen & Jiang, 2021). For example, in a study exploring thirty Chinese-Australian children's HL maintenance (children aged 10-11) (Shen & Jiang, 2021), for

some children who achieved highly in a weekend Chinese school, they were self-motivated and set further goals to better develop their Chinese literacy. In contrast, a girl reported that she felt less motivated to learn Chinese as she found the homework from her community school was difficult for her and she did not receive enough support from her Chinese mother (Huang & Liao, 2024). Similarly, in some families with strict language policies of practising Chinese set by parents, children could feel negative emotions, such as pressure and anxiety, when speaking Chinese, and they resisted these language policies (Shen & Jiang, 2021; Wang, 2023).

As discussed in section 2.2.3, when looking into FLP in a broader context, it can be viewed as fluid and influenced by various sociocultural situations (Curdt-Christiansen & Huang, 2021). Similar to heritage families in other ethnic groups, studies within Chinese heritage families also found that handling mainstream educational needs while maintaining Chinese with limited resources could be challenging (Huang & Liao, 2024; Liang & Shin, 2021). For example, within the UK context, in a study that involved 66 families from three ethnic groups (Chinese, Italian, and Urdu-speaking Pakistani) in Reading, UK (children aged from 2 to 8 years old) (Curdt-Christiansen & Morgia, 2018), parents valued the maintenance of Chinese, and over 86% of the Chinese parents communicated with their children in oral Chinese. But some Chinese parents mentioned that they prioritised children's educational needs and schoolwork as they felt the stress to enhance children's English development, which led to a lower expectation on their children's Chinese literacy development (Curdt-Christiansen & Morgia, 2018). In another study with 212 multilingual families that involved nine Chinese-speaking families in the UK, formal schooling in English had an impact on children's HL maintenance with a significant increase in the use of English (Little, 2020). Some parents reported that their children became unwilling to speak HL after entering school for a period; for example, a Chinese parent found her 13-year-old daughter mainly spoke English and lost some Chinese communication skills (Little, 2020).

When looking into more research within the UK context, some studies have been done to investigate children's bilingual/multilingual practices through social media within Chinese heritage families (Curdt-Christiansen & Iwaniec, 2023; Zhao & Flewitt, 2020). In a study involving six families from Chinese and Polish communities in England (three families each) (Curdt-Christiansen & Iwaniec, 2023), the findings suggest that emotion is a crucial factor that influences FLP; HL languages often carry intimacy and emotional expressions in these families, no matter offline or online. In this study, children's ages varied from 3.5 to 12 years old. For the one Chinese family with girls aged 7 and 12, emojis were used along with Chinese when the family chatted online to demonstrate affection; for the 3.5-year-old boy, he made videocalls with his remote grandfather to comfort him and convey emotions (Curdt-Christiansen & Iwaniec, 2023). Similar findings of using emojis/stickers and making video calls through social media to convey emotions were also found in a study with nine Chinese immigrant families involving children under 8 years old (Zhao & Flewitt, 2020). With a focus on an interlingual family with a Chinese mother, a Portuguese father, and two boys (8 and 6), translanguaging practices of Chinese, English, and Pinyin were found when the 8-year-old boy chatted with his mother's remote friend on a Chinese social platform (Zhao & Flewitt, 2020).

As discussed in this section, research on FLPs within Chinese heritage families has flourished in recent years. Since each family may have varied backgrounds, most of these studies were designed as case studies to gain in-depth understandings of the language choices within specific family settings. My study design of multiple case studies follows this trend. Meanwhile, as some previous studies have involved preteens (e.g., Shen & Jiang, 2021), or children in a wide age group (e.g., Tang & Zheng, 2023; Curdt-Christiansen & Iwaniec, 2023), there is a need to investigate FLPs within Chinese heritage families, with younger children in narrower age groups.

2.2.5 Translanguaging and code-switching

2.2.5.1 Definitions

In studies of bilingual children's emergent language activities, translanguaging processes have often been investigated (Kirsch, 2020; Song, 2016; Wei & García, 2022). The term translanguaging was first introduced by Cen Williams in Wales to describe an educational strategy in which bilingual children use both of their languages (Stroupe et al., 2019). The concept of translanguaging can be defined from a linguistic perspective, as "the deployment of a speaker's full linguistic repertoire without regard for watchful adherence to the socially and politically defined boundaries of named (and usually national and state) languages (Otheguy et al., 2015, p. 283)." In other words, translanguaging should be viewed as a dynamic process that is not confined to traditional language systems; it is about moving fluidly between languages to meet communicative and meaning-making purposes more effectively and creatively (Wei, 2018). A bilingual child's full linguistic repertoire involves their personal language skills that are shaped through their daily communication experiences; it should be viewed as whole and unique (Otheguy et al., 2015). For bilingual children, they can fully use their unique and distinctive language skills during the translanguaging process since the boundaries between specific languages are blurred (García & Otheguy, 2020).

When studying bilingual language practices, another concept named code-switching (Cantone, 2007) is also frequently discussed. It is necessary to distinguish the two terminologies, translanguaging and code-switching. Compared to translanguaging, the definition of code-switching could be more stressed in the linguistic and grammatical fields (Gross et al., 2022; Wei, 2018). Even though code-switching research sometimes shows different rules, the main idea about code-switching still follows some basic grammar rules, which might be different from the usual grammar of each language (Cantone, 2007). The concepts of code-switching or code-mixing are based on the idea that each language has its own language structure and cognitive constructs (Wei, 2018). Different from the concept of translanguaging, the importance and creativity of many mixed language expressions seem not to be fully explored through the lens of code-switching (Wei, 2018). Furthermore, many code-switching studies are largely theoretical and descriptive, as they primarily rely on acceptability tests (Cantone, 2007; Gross et al., 2022; Kuzyk et al., 2020). For example, in a study exploring the code-switching practices of young Dutch-English bilinguals aged 2-3, seven types of code-switching and four motivational factors such as social, metalinguistic, lexical, or conversational were identified (Sczepurek et al., 2022).

From my perspective, code-switching is more about changing or switching between two different languages with specific language divisions, and it focuses on studying the language grammars linguistically. In my study, I view all the bilingual/multilingual children's linguistic repertoire as unique and whole during their family language practices because I respect the creativity and meaning-making process when a child mixes two or more languages together to communicate with others.

2.2.5.2 Translanguaging in the family context

It is argued that great efforts have been made to involve translanguaging pedagogies in early childhood education and care (ECEC) settings, and research has indicated that these techniques lead to a range of positive outcomes for young students (Kirsch, 2020). While plenty of research examines the translanguaging practices within school and pedagogical contexts (Charamba, 2020; García & Otheguy, 2020; Kirsch, 2020), there are some studies exploring the translanguaging nature of bilingual children's language practices in the home context (Jung, 2022; Karpava et al., 2021; Song, 2016).

In Song's (2016) study with four Korean-English bilinguals who were aged between 6 and 8 years in a big southwestern city in the US, their translanguaging practices during the home literacy activities were discussed. It was discovered that the children and their family used the two languages flexibly for meaning negotiation, which benefitted the children's linguistic repertoire expansion in both English and their heritage language (Song, 2016). A more recent study (Karpava et al., 2021) explored the translanguaging practices of 30 Russian-speaking families in three countries, Sweden, Greece, and Estonia (10 families in each country), translanguaging practices were found in these families, as they integrated Russian with the local languages (Swedish, Greek, and Estonian) to make family communication more effective and express their cultural identities (Karpava et al., 2021). Meanwhile, the study emphasises several translanguaging strategies, including the use of multiple languages in daily communication, the use of language-mixing to improve interaction and comprehension, and the blending of linguistic resources from Russian and the major language of their area (sometimes in English as well) (Karpava et al., 2021). In another study involving six Korean-English bilingual families in Korea (children aged from 5 to 16 years old), translanguaging took place naturally and was a common practice for communication at home (Jung, 2022). According to the study, translanguaging practices allowed the children to fully use their whole linguistic repertoire and develop their sense of self-identity (Jung, 2022). Besides these studies, in a study examining the diary entries of a second-grade Korean-English bilingual boy in the United States, translanguaging practices were commonly spotted in his diaries, these practices helped him show his bilingual and bicultural identity (Choi, 2024). He sometimes used paintings to enrich his written content; for example, he wrote in one language and then added extra contexts in another language, and he often illustrated speech bubbles or notes in both languages (Choi, 2024).

Combining the findings of the above studies, from my perspective, as the home environment is crucial for children to practise and develop their heritage language (Little, 2024), translanguaging practices at home should be given equal attention as the translanguaging practices in the formal school environment. Therefore, in my study, the translanguaging practices during the young bilinguals' home touchscreen activities are discussed in detail in Chapter 4 and Chapter 5.

2.3 Parents' role and the home context related to children's touchscreen use

Studies have pointed out that children's digital literacy practices need to be researched in particular circumstances (Harrison & McTavish, 2018; Marsh et al., 2018; Prinsloo, 2019). The home environment and parents' role are significant in children's daily lives (Siibak & Nevski, 2019).

2.3.1 Home environment

Since it is the first place where children engage in a variety of everyday activities, the home environment has a significant impact on children's lives and affects their emergent literacy (Morgade et al., 2019; Siibak & Nevski, 2019). Home is more than a geographical space; it is also a vital space for children to build close bonds with other family members. To some extent, the two words 'family' and 'home' can be used interchangeably (James, 2012). In Mandarin Chinese, '家' means 'home' and '家人' is the vocabulary for 'family', the same Chinese character '家' is used in both words. In Chinese cultural context, family and home are often used interchangeably.

2.3.2 Parents' significant role

It is important to understand parents' role in their children's digital practices since they are frequently involved in the daily lives of children and have a substantial impact on children's learning and development (Bronfenbrenner, 1979). The home environment and parents' role in supporting and navigating their children during their home digital use are also crucial (Soyoof et al., 2024). Studies have acknowledged parents and other family members' substantial influences on children's touchscreen use (Marsh et al., 2018; Siibak & Nevski, 2019). Meanwhile, parents can play a critical role in facilitating their children's digital literacy development; children's digital literacy and digital use are largely influenced by parental attitudes and mediation (Ozturk & Ohi, 2022). When looking into parents' role in digital activities in heritage families, parents act as not only gatekeepers but also enablers and instructors in their children's HL development (Little, 2020). In other words, parents play a crucial role in promoting their children's HL development when accessing digital contents; they thoughtfully pick the related resources for children and may engage in these activities together with their children (Little, 2020). Some parents choose apps with specific educational features to meet their goals of using apps to facilitate their child's literacy development; while parents may consider some apps that children engage with as entertaining and educational, their children may hold different opinions about these apps (Little, 2020).

2.3.3 Parents' screen attitudes

Children at a young age obtain and acquire new knowledge primarily through attentive observation of their surroundings and imitation of modelling behaviours (Bandura, 1977). Children may see and mimic their parents' screen-using behaviours, and parents screen use is largely influenced by their attitudes. Various studies have been conducted to explore parental attitudes and children's adoption of home touchscreens; the studies frequently show both favourable perceptions and concerns (Chaudron et al., 2019; Ebbeck et al., 2016; Hinkley & McCann, 2018; Nevski & Siibak, 2016). Although some parents recognised the educational benefits of the use of digital technologies at home and offered a range of digital devices and apps for their children, they also expressed concerns about the overuse of screens (Ozturk & Ohi, 2022).

A widespread worry is that the expansion of adapting digital devices might have risks that outweigh the potential advantages (Lim, 2016; Livingstone et al., 2019). Some frequent worries include the possible consequences of developing unhealthy screen habits (Hinkley & McCann, 2018), the potential for physical health problems including eyesight damage and addiction issues (Ebbeck et al., 2016; Hao, 2023), and the exposure to harmful or unhealthy contents (Bentley et al., 2016). In a study conducted with four Chinese-heritage families (children aged from 4 to 5 years old) in the United States to explore parental views on using digital tools to develop languages (Hao, 2023), it was found that the parental attitudes on technology were affected by many factors, such as their own childhood language learning experience, technology use patterns, and the quality of accessible digital resources. Some parents expressed negative attitudes towards children's use of digital devices for language development and believed that it was better to let their children develop languages with traditional print-based literacy activities (Hao, 2023).

In addition to the above, long-term sedentary screen-viewing activities are considered to be harmful. A study pointed out that excessive sedentary screen-viewing time could cause potential harms to children, such as an increased risk of obesity (Zhu et al., 2019). Research has indicated a correlation between extended screen-viewing time and the potential language delay of preschool children, as spending a long time watching screen contents may hinder children's fulfilment of vital developmental goals

for both language and other critical areas (McArthur et al., 2022). Conversely, physical activities are often linked to beneficial influences on children's health (Jago et al., 2010). Sebire et al. (2011) found that some parents may choose to participate in physical activities with their children as a replacement for their children's screen use and reduction of their children's screen time.

Taking both the recreational and educational advantages of children's touchscreen adoption into account (Brito et al., 2017), some parents view children's digital activities as equally necessary and challenging (Kumpulainen & Gillen, 2019). It is argued that parents need to receive guidance and support to better understand how to use technology in their home and facilitate children's literacy development with proper digital resources (Hao, 2023; Ozturk & Ohi, 2022).

2.3.4 Parental mediation (PM) in children's home touchscreen adoption

While lots of studies have been done to explore parental attitudes towards children's digital adoptions, only some studies have focused on the area of parental mediation (PM) in children's home touchscreen use (Zaman et al., 2016). PM can be generally defined as strategies that parents use to alleviate the negative effects on children's health and multiple developments (Mendoza, 2009). The importance of PM at home in children's socialisation and development should be stressed (James, 2013; Morgade et al., 2019). It is reported that the digital adoptions of children aged below eight years old greatly rely on adults' supervision and are often monitored by parents, teachers, and caregivers (Livingstone et al., 2019). With the growing engagement of touchscreens at home, PMs on the use of social media apps or digital toys should be studied (Morgade et al., 2019). In my study, the role of PM needs to be considered more within the current digital context.

Several types of PM strategies in children's digital use at home have been identified and discussed in previous studies. In a study (Nikken & Jansz, 2014) on PMs and children's digital use at home, the researchers surveyed 792 Dutch parents whose children aged between 2 and 12 about their children's internet use. There were three commonly used PM activities during these children's screen time: restrictive mediation, active mediation, and co-use activities (Nikken & Jansz, 2014). In this study, restrictive mediation meant some restrictions on the children's internet use, such as prohibiting online games or setting limitations on a child's screen time and managing the contents they can access; active mediation included strategies that parents used to actively facilitate their children's internet use safely and smoothly; and co-use was a strategy through which parents and children used the internet together (Nikken & Jansz, 2014). Apart from the three PM strategies, two other strategies, namely supervision and technical safety guidance, were also found in this study: parental supervision sets strict rules that the child could only use a computer together with the parents or get parents' permissions to do so; technical safety guidance involves specific actions to create a safer online environment (e.g., installing safety apps) (Nikken & Jansz, 2014).

In another study conducted with 24 families with 3-9 year-old children in Belgium (Zaman et al., 2016), the families used a variety of digital devices, including touchscreen tablets and smartphones; restrictive mediation, active mediation, and co-use PM strategies were found in this study as well. As multiple devices were used at home, PM strategies were more complex compared to Nikken and Jansz's (2014) study. For example, restrictive mediation methods were found on children's use of devices, location of digital activities, purchase restrictions, and the limited screen time and accessible contents of the children (Zaman et al., 2016). Active mediation strategies include discussions between parents and children on varied media-related topics, such as the proper content, negotiations on the time limit, and the purchase of

digital resources (Zaman et al., 2016). In Zaman et al.'s (2016) study, it was also found that the active mediation and co-use strategies were always interwoven together and formed the strategy called participatory learning, which includes parent-child co-use and co-explore on the operational skills or contents of some devices and apps. Parents used this strategy when they wanted to acquire digital literacy skills for their child or themselves (Zaman et al., 2016). In addition, a new PM style called distant mediation that combined two monitoring methods, deference and supervision, was found in that study; parents chose to not intervene and gave children freedom to explore digital activities independently while keeping an eye on their digital use nearby (Zaman et al., 2016).

In both studies, parents often combined different PM strategies to monitor their children's digital use (Nikken & Jansz, 2014; Zaman et al., 2016), some parents tried to balance the limitations they set with their child's wishes and autonomy. Similarly, in a narrative review examining the influence of PM on the home digital literacy experiences of children aged 0–8 from 2010 to 2021 (Soyoof et al., 2024), the three PM strategies mentioned in both above studies were discussed. In this review, the features of each mediational category were analysed: the restrictive mediation often contained the element of setting and enforcing some rules to navigate children's digital use; the characteristic of active mediation was more on discussing or negotiating how to better use digital resources and minimise the potential harms to children; and for PM of co-use, the emphasis was on parents' accompaniment and how to engage with the children's digital activities together (Soyoof et al., 2024). While research on PM has explored multiple restrictive mediation strategies, less research has recognised the diverse PM strategies of active mediation and co-use (Scott, 2022). With supportive PM, preschool children could develop multiple skills through their family digital media use (Scott, 2022). Children could benefit from their engagement with digital technologies, as the related digital literacy practices greatly facilitate their acquisition of skills in different aspects, such as emergent language and literacy skills, socio-emotional competences, technological proficiency, and STEM skills (Soyoof et al., 2024).

Parental mediation (PM) in bilingual families

Apart from the significant influence of parents' attitudes, PM can also be associated with multiple factors, such as parents' gender, educational level, socioeconomic and cultural backgrounds, digital skills (Kumpulainen & Gillen, 2019; Soyoof et al., 2024), and children's age (Nikken & Jansz, 2014; Soyoof et al., 2024). When looking into studies on the PM strategies for children's digital activities in bilingual families, the uses of HLs and the dominant language during the children's family's digital technology use vary. For example, in a study conducted with five Iranian families including six children aged 6-7 in Iran (Soyoof, 2022), the mothers stated that they only let the children use digital resources at home in English rather than their home language, because they believed that these digital literacy practices could facilitate their children's English development and be vital for their future education. Similarly, in a study conducted with 141 bilingual families in Singapore (children aged from 3 to 6) (Sun et al., 2022), some children engaged with more home touchscreen activities in English rather than in their home language, as the parents mentioned that meeting educational goals in English was the main purpose for their children's touchscreen use. However, in a study that included 225 Chinese-English bilingual children who were 7 years old in Singapore (Haoning Mah et al., 2021), for some families who mainly communicated in English at home, parents also selected digital resources in both English and Chinese to facilitate their children's bilingual development; it was found that their children developed better reading skills in both languages with this kind of parental mediation.

From the above studies, children's bilingual digital literacy practices during home digital use are largely influenced by different PM strategies towards language use during these activities. It can be seen from these studies of PM that the strategies keep increasing and developing since children's home digital use has been changing rapidly in recent years. Rather than focusing on studying the potential risks and restricting rules, more studies should be done to explore how children use digital devices to facilitate their language and literacy practices and how parents can effectively support these experiences. In my study, the specific PM strategies in each family are discussed in Chapter 4 and Chapter 5.

2.3.5 Parent-child interactions and touchscreen use

As discussed above, the co-use and active PM strategies with newly developed digital tools such as touchscreens can encourage interactions between parents and their children. For instance, using a touchscreen instead of a co-playing toy or co-watching TV was found to improve parent-child interactions in a laboratory trial environment (Skaug et al., 2018). Like this, it was discovered that co-using iPad activities with children (ages 2-6) in a simulated home environment enhanced parent-child communication quality, since a variety of scaffolding methods, such as verbal or physical supports, were involved throughout the co-use activities (Wood et al., 2016).

Also, parent-child interactions with high quality during their touchscreen time could facilitate children's language and literacy growth. It is argued by scholars that the interactions between parents and children during their use of touchscreen devices could help children develop their language skills and help them acquire educational topics through well-designed touchscreen apps (Sheehan et al., 2019). For instance, in Neumann's (2016) study among 2-4-year-olds, positive relations were found between the frequency of using touchscreen apps at home and the development of print awareness. Similarly, research found that toddlers might acquire more new words through live videos (such as Facetime) when their parents provided appropriate responses to the video contents (Strouse et al., 2018). Additionally, compared to traditional picture books, using iPad apps may present new opportunities for parents and children to read and share their own stories with multimodal and multimedia effects (Kucirkova et al., 2013). By fostering close parent-child interactions throughout the process, children's language development can be positively influenced (Kucirkova et al., 2013). In a study exploring the parent-child co-reading activity with digital books in four bilingual families in Malta (children aged from 4 to 7) (Mifsud et al., 2021), the families used e-books as an additional tool along with the reading of print-based books in their daily lives. They used available e-book resources in both Maltese and English; intensive parent-child interactions in both languages were found during this co-reading activity (Mifsud et al., 2021).

However, concerns have been raised regarding the detrimental effects of using digital devices for parenting. According to some studies, several parents use digital devices to distract their children so they can focus on their own work or enjoyment (Hiniker et al., 2020). A study involving 15 parent-child pairs discovered that playing with touchscreens probably caused parents and children to reply or engage with one another less frequently than playing with toys (Hiniker et al., 2018). Additionally, when parents use their own touchscreen devices or apps, they tend to be less attentive and receptive to their children, resulting in poor parent-child interactions that could have a negative effect on children's emotions and various developmental stages (Kildare & Middlemiss, 2017).

As seen from the above studies, parent-child interactions during their home digital screen use differ in different backgrounds, and how families practise digital literacy

during parent-child interactions should be studied within specific situations. In my study, the patterns of parent-child interactions during a child's home touchscreen use are examined within each family, with a focus on the use of different languages.

2.4 Theoretical underpinning of my study

As my study mainly investigates children's language choices and touchscreen use in their home contexts, I researched Bronfenbrenner's (1979) ecological model to understand the influences of multiple environments in a child's development. In this section, I will introduce Bronfenbrenner's ecological systems theory (1979) and how this original model has been critiqued and expanded upon. Then, I discuss the importance of applying Bronfenbrenner's more recent bioecological model (2006) as the theoretical underpinning for my research.

2.4.1 The ecological systems theory

In Bronfenbrenner's (1979) ecological systems theory, it is important to evaluate children's development in connection to surroundings like family and community rather than in isolation (Harrison & McTavish, 2018). According to this model, interactions within several nested environments (micro-, meso-, exo-, macrosystem) shape children's developments (Bronfenbrenner, 1979). The following are the brief explanations of each system.

Microsystem

The microsystem is the system that I stress the most in my study, it involves activities, roles, and close relationships with people that a person experiences in environments with specific physical and material features (Bronfenbrenner, 1979). Relationships that children have with their parents, siblings, close relatives, friends, kindergarten teachers, and others are key elements to form microsystems (Siibak & Nevski, 2019).

Mesosystem

In the mesosystem, how the interactions and interconnections between two or more microsystems can affect a child's development is emphasised (Bronfenbrenner, 1979). For example, how the relationship between home and school can influence a child's language development.

Exosystem

The factors in the exosystem are social structures that indirectly interact with a child and have influences on the microsystems (Bronfenbrenner, 1979). For example, extended families who live remotely in another country, parents' jobs, and local school requirements, are all factors in the exosystem of a child's life.

Macrosystem

The macrosystem emphasises broader social and cultural contexts that influence a child's development (Bronfenbrenner, 1979), such as national education policies and cultural beliefs. Factors in the macrosystem subtly influence people's interactions and activities within microsystems (Guo & Lee, 2023); changes in the macrosystem can greatly influence the lower-level systems (Paat, 2013).

However, Bronfenbrenner's (1979) ecological model has been criticised by some scholars. This original ecological model lacks the focus on the influence of personal characteristics and individual differences on their development (Wachs, 2000). For example, although the ecological model emphasises the importance of understanding

a person's development within contexts in different layers, it does not consider the role of a person's self-resilience level in problem-solving during a difficult situation (Christensen, 2016). In addition, Bronfenbrenner's (1979) ecological model has been criticised for being too static and unable to illustrate the intricate, dynamic multi-layer processes when talking about children's digital literacy activities (Sefton-Green et al., 2016). According to Network System Theory (Neal & Neal, 2013), the ecological systems should be redefined as overlapping rather than nested. Bronfenbrenner's ecological model should be viewed as dynamic instead of static when studying digital literacy practices, and the intersectional relationship among layers should be stressed (Morgade et al., 2019). In my study, the multiple systems mentioned in this model should be viewed as overlapping and influencing each other.

Bronfenbrenner himself also reflected on the drawbacks of the original model, he questioned the overemphasis on the role of environments in individual's development (Tong & An, 2024), and he brought up the idea of transiting the focus of his ecological model from the environment to the processes of a person's development, forming initial thoughts of the bioecological model (Bronfenbrenner, 1986). In the following section, I will explain the bioecological model in detail and discuss the importance of adopting this more recent model as the theoretical framework of my study.

2.4.2 Bronfenbrenner's bioecological model

The bioecological model is not a static model, it keeps evolving and has been developed over time to better reflect human development (Bronfenbrenner, 2005). Four key elements function as the defining properties in this model: Process, Person, Context and Time (Bronfenbrenner & Morris, 2006). Each of the defining properties is explained as follows:

2.4.2.1 Proximal processes

The proximal processes refer to the consistent and frequent interactions between a person and their immediate environment; these processes primarily and significantly influence a person's development (Bronfenbrenner & Morris, 2006). Bronfenbrenner and Morris (2006) explained the definition of proximal processes in Proposition I of the bioecological model, as the following quotation demonstrates:

> Especially in its early phases, but also throughout the life course, human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment. To be effective, the interaction must occur on a fairly regular basis over extended periods of time. Such enduring forms of interaction in the immediate environment are referred to as proximal processes. (Bronfenbrenner & Morris, 2006, p. 797)

Compared to the original model proposed in 1979, the bioecological model clearly distinguishes process and environment. The original model believes that interactions within the microsystem directly influence a child's multiple areas of development (Bronfenbrenner, 1979). Instead of categorising interpersonal interactions as part of the environment, the bioecological model places interactions as processes (Bronfenbrenner & Morris, 2006). Children's group or independent play, engaging with activities to develop new skills, reading, are all examples of proximal processes.

In the bioecological model, proximal processes include not only interpersonal interactions but also interactions with symbols and objects (Bronfenbrenner & Morris,

2006). These symbols and objects should be accessible in a person's immediate environment, and they should be designed with features that draw a person's attention, encourage their curiosity, operation, illustration, and creativity when interacting with them (Bronfenbrenner & Morris, 2006). Considering the features and popularity of touchscreens discussed in section 2.1.2, touchscreen devices belong to the category of objects that a child may frequently engage with in their daily family life; proximal processes take place during their touchscreen activities.

2.4.2.2 Person

Introducing Person as a key element in the bioecological model fills a gap in the original ecological model that has been criticised for lacking the acknowledgement of personal characteristics on a person's development (Christensen, 2016; Wachs, 2000). Three kinds of characteristics of Person influence an individual's development by affecting how proximal processes emerge and conduct; they are forces, resources, and demands (Bronfenbrenner & Morris, 2006). The forces, the character of a person, especially the active disposition of a person (such as motivation and persistence), can facilitate the start of proximal processes and make interactions move forward (Bronfenbrenner & Morris, 2006). The second characteristic is called resources, which includes a series of mental and emotional skills, knowledge, and experience that affect how a person can efficiently engage in interactions within their environment (i.e., proximal processes) (Bronfenbrenner & Morris, 2006; Tong & An, 2024). The third one is called demand characteristics, it involves a person's visible features, such as appearance (Bronfenbrenner & Morris, 2006). This characteristic can invite or discourage the initial interactions and responses from the environment, as other people may form immediate expectations based on the demand characteristics of a person (Tong & An, 2024).

2.4.2.3 Contexts

The definition of contexts in the bioecological model is similar to the original ecological model, which includes the concepts of microsystem, mesosystem, exosystem, and macrosystem (Siraj & Huang, 2020; Tong & An, 2024). The explanation of each system is written in the above section 2.4.1. Combining relationships of other defining properties and contexts, the definition of microsystem has been expanded as well. A microsystem in the bioecological model involves not only activities and relationships among people that a person experiences in an environment with specific physical and material features (Bronfenbrenner, 1979), but also how the physical, social, and symbolic characteristics of an immediate environment can positively or negatively influence the consistency and complexity of a person's interactions in these environments (Bronfenbrenner & Morris, 2006; Bronfenbrenner, 1994). In other words, the upgraded definition of microsystem emphasises how features of contexts can influence a person's complicated proximal processes and development. For example, in a study investigating 51 French-English bilingual children's (aged 4) language exposure and vocabulary development in Canada (MacLeod et al., 2024), the bioecological model is applied to examine how family and community support can facilitate the bilinguals' language development. In this study, while putting the child's internal factors in the middle, family language practices are placed in the microsystem, community sociolinguistic context is put in the exosystem, and the macrosystem includes broader linguistic contexts in Canadian society (MacLeod et al., 2024). In the microsystem, parents actively mediate and engage with their children's maintenance of the minority language (MacLeod et al., 2024); these parent-child interactions at home positively influence their child's bilingual development.

Moreover, as digital technology has been integrated into children's family life for a long time, the influence of technology on children's language development should be

stressed. Johnson and Puplampu (2008) stated that an ecological techno-subsystem should be included in the microsystem as an enhancement to the ecological model. This new subsystem includes children's engagement with technology tools in the microsystem environment, in addition to their interactions with humans and communication artefacts (Johnson & Puplampu, 2008). For instance, computers, the Internet, telephones, software, television, e-books, and portable digital devices are all part of the techno-subsystem; a child can engage with these digital tools and form interactions with not only people but also these non-living tools in their home environment (Johnson & Puplampu, 2008). In my study, the bilingual/multilingual children's use of touchscreens fits into the techno-subsystem, as the interactions between touchscreens and children in the home environment are also part of their daily lives.

2.4.2.4 Time and chronosystem

Like the defining property of Person, Time is another innovative dimension of the bioecological model compared to the original ecological systems theory (Bronfenbrenner & Morris, 2006). As mentioned above, any effective proximal processes must involve regular interactions within an environment for a period; therefore, Time influences proximal processes and a person's development. In the bioecological model, Time can be understood from three levels: microtime, mesotime, and macrotime (Bronfenbrenner & Morris, 2006). Microtime is about how continuous a specific set of interactions take place, for example, daily; mesotime refers to the regularity of interactions over longer periods, such as weeks or months (Bronfenbrenner & Morris, 2006). Macrotime can be understood as the changing situations and events in broader society during a person's lifespan and the history during which the person has lived (Bronfenbrenner & Morris, 2006). At the macro level, time emphasises the influence of life transitions, major events, and societal changes over a child's lifetime on their developments (Guo & Lee, 2023). For example, the starting of school, changing of family situation. The time dimension can also be interpreted as a chronosystem (Bronfenbrenner, 1994), which includes consistent change over a period, of both the Person characteristics and the real-life contexts in which a person lives.

2.4.2.5 Process-Person-Context-Time (PPCT) model

After briefly explaining the four defining properties, I will illustrate how all the four elements are interactively related to each other (Bronfenbrenner & Morris, 2006), starting with a quotation of Proposition II of the bioecological system:

> The form, power, content, and direction of the proximal processes effecting development vary systematically as a joint function of the characteristics of the developing person, the environment—both immediate and more remote in which the processes are taking place, the nature of the developmental outcomes under consideration, and the social continuities and changes occurring over time through the life course and the historical period during which the person has lived. (Bronfenbrenner & Morris, 2006, p. 798)

Combining Proposition I and Proposition II, an effective proximal process must directly include the developing person, and it should be a regular and reciprocal process over a period (Bronfenbrenner & Morris, 2006). In other words, a proximal process can be measured in three dimensions: the first is whether the progressive complexity of the proximal processes leads to actual development or challenges; the second dimension is the length and frequency of the processes; the third dimension is whether the interactions are bidirectional and mutual (Navarro et al., 2022). As illustrated in diagram 1, the four defining properties interrelate to each other, and their relationships

should also be viewed as bidirectional. For instance, while the characteristic of the developing person plays a vital role in proximal processes, proximal processes can evolve progressively and influence the characteristics of the developing person as well (Tong & An, 2024).

Meanwhile, as mentioned in Proposition II, proximal processes are core to a person's developmental outcomes (see the red arrow in diagram 1) , and whether proximal processes work effectively is influenced by the developing person, contexts (immediate and remote environments), time at all levels, and the developmental outcomes. Therefore, the developmental outcomes also interrelate and form reciprocal relationships with the four defining properties. While the developing person, the change of time and context significantly influence proximal processes and the developmental outcomes, the developmental outcomes may change a person's characteristics (e.g., the development of new skills) and change the time and context to activate more complex and effective proximal processes for further developmental needs (Bronfenbrenner & Morris, 2006).

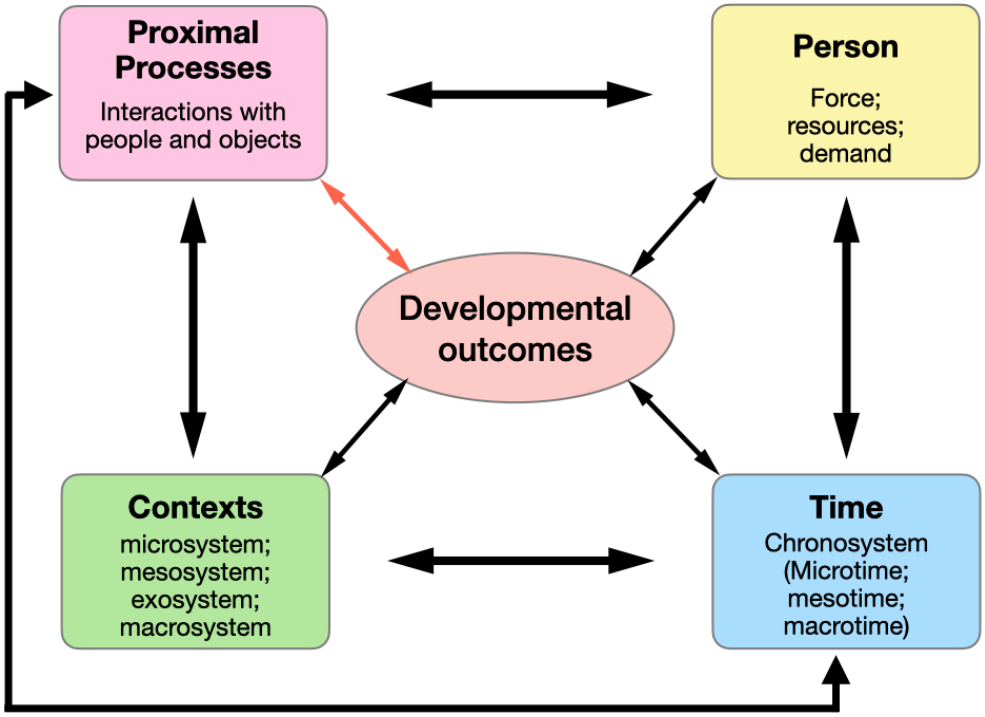

Diagram 1 Process-Person-Context-Time (PPCT) model

During a research design, the Process-Person-Context-Time (PPCT) model is introduced to explore the interrelationships of the four elements on an individual's development and how these elements function together to influence the developmental outcomes (Bronfenbrenner & Morris, 2006). The four components correlate and work together in the PPCT model to achieve better developmental outcomes instead of functioning separately (Navarro et al., 2022; Siraj & Huang, 2020). To put this PPCT model into practice, Bronfenbrenner and Morris (2006) believe that focusing on exploring interactions between Person and Context in multiple groups can facilitate the analysis of how developmental outcomes evolve and change over a period (Tong & An, 2024).

One of the main reasons that I adopt the bioecological model as the theoretical underpinning of my study is that this model emphasises the role of proximal processes

and the Process-Person-Context-Time interrelationships on a person's development. After reviewing 26 studies applying Bronfenbrenner's bioecological model in intercultural and international contexts, Tong and An (2024) argue that this model provides educators with a useful and detailed framework to understand and explore the complexities of international and intercultural education. In my study, as my main research aim was to understand children's family language choices and digital literacy practices with touchscreens in six Chinese heritage families, I investigated these children's interactions with not only family members but also with touchscreen devices. The concept of proximal processes in the bioecological model includes both interpersonal interactions and interactions with objects and symbols in a person's immediate environment (Bronfenbrenner & Morris, 2006), which fits into my research design.

In addition, embedding the specific elements of Process, Person, Context and Time into a research project can benefit the understanding of research questions, and involving several proximal processes rather than one process in a PPCT model is argued to be more effective when examining development (Bronfenbrenner & Morris, 2006). Following the Process-Person-Context-Time model, I can better understand the relationships among these bilingual children's (Person) language and literacy developments through touchscreen activities and other family activities (multiple Processes) within their home environments, while acknowledging the influence of other factors in different systems on children's language choices (Context) during the research data collection (Time).

Apart from the above consideration, I also want to discuss two more reasons why I think the bioecological model is important for my study. One reason is that compared to the original model in 1979, the bioecological model (2006) demonstrates children's active role in their own development; another reason is the emphasis on the bidirectional relationships between systems.

2.4.2.6 Human agency and children's active role

Human agency can be understood as how a person actively engages in activities, makes decisions for themselves, and influences their own development within specific environments and situations (Bronfenbrenner & Morris, 2006; Elder, 1998). In the bioecological model, the relationship between the defining property Person and proximal processes can clearly illustrate how a child can actively engage in their own development. For example, in a paper reviewing several studies that investigate children's sense of belonging to school through the lens of the PPCT model (El Zaatari & Maalouf, 2022), the active role of students when it comes to influencing their development is illustrated through the three kinds of Person characteristics: active behavioural disposition, resource, and demand characteristics. As proximal processes include both interpersonal interactions and interactions with objects and symbols (Bronfenbrenner & Morris, 2006), a child's role in the two different types of proximal processes should be discussed separately.

During proximal processes that involve interpersonal interactions, the three main types of Person characteristics can greatly shape proximal processes and influence further development (Bronfenbrenner & Morris, 2006). As explained previously about the three kinds of characteristics related to my research topic, a child's force characteristics or dispositions, such as their curiosity and persistence, may influence how they interact with people in their surrounding environments. For example, a child may voluntarily practise their heritage languages more after a trip back to their parents' home country or based on their own interests in developing their HLs. The resources refer to the experience, skills, and knowledge that a person is already equipped with;

for example, a child may choose to use different languages when talking to different people, using their equipped language skills and according to their experiences of interacting with these people. The demand characteristics can affect how they engage with their environments. For example, a younger child may demonstrate that they need more help from their parents when playing with some apps or practising languages.

In addition, in the bioecological model, when the proximal processes involve more people other than the developing person, the characteristics of each person during interpersonal interactions can influence the processes and further developmental outcomes (Bronfenbrenner & Morris, 2006). In other words, while a child's characteristics play an active role in their interactions with other people, other people's characteristics also influence their interactions with the child and the child's development. Children in early childhood primarily interact with their parents regularly at home; when they grow older and more complex proximal processes take place progressively, they engage with more people (e.g., friends, teachers, relatives, and siblings) and participate in more diverse activities (Bronfenbrenner & Morris, 2006). These bidirectional interactions with people in their immediate environment, especially with parents in the early stages, can facilitate children's multiple developments and foster attachment and close relationships (Bronfenbrenner, 1989, 2005). In my study, I examined the role of parents and how parent-child interactions facilitate a child's touchscreen activities and language practices. By applying the bioecological model, I tried to understand the progressively complex interactions between the children and their parents, siblings, and (remote) relatives during their various touchscreen activities and daily communications.

Compared to interpersonal interactions, without the presence of other persons, a child plays a more active role during their independent interactions with objects and symbols (Bronfenbrenner & Morris, 2006). As these activities do not involve other people, the developing person's dispositions and resources are the two main characteristics that actively influence the proximal processes (Bronfenbrenner & Morris, 2006). In my study, touchscreen devices are the objects that children frequently engage with in their home environments; some children prefer to engage with touchscreen apps independently, while others would like parents to accompany them during touchscreen activities. During independent touchscreen activities, children may choose apps based on their own interests and use their digital literacy skills (e.g., using their fingers to interact with the touchscreen interfaces) and language skills during these activities. Therefore, embedding the bioecological model and exploring the specific proximal processes in independent touchscreen activities are vital to understanding children's language and digital literacy experiences in my study.

2.4.2.7 Bidirectional relationships/interactions between systems

Another feature of the bioecological model is also vital for my study design. As mentioned in Proposition I and Proposition II, proximal processes include bidirectional interactions that take place in both immediate and relatively remote environments over a time period (Bronfenbrenner & Morris, 2006).

The first layer of bidirectional relationships is between the developing person and people or objects that they interact with. For example, for the interpersonal interactions between parents and a child at home, knowledge is exchanged, and their communication is reciprocal. And for the interactions between a child and a touchscreen device, while a child may actively engage in choosing and playing an app, the app also responds to the child's operations or gives new gaming instructions.

The second layer of bidirectional relationships is among different systems or contexts;

for example, how different microsystems (e.g., home and school) influence each other reciprocally in the mesosystem (Bronfenbrenner, 1994). Bronfenbrenner constantly emphasises the dynamic relationships between the developing person and their contexts, especially the significant influences of interactions between a person and their environments on development (Tong & An, 2024). In addition, Johnson and Puplampu (2008) mentioned the bidirectional interactions and relationships among and within different systems when analysing children's Internet use. For example, parents' use of the Internet during work (exosystem) may implicitly influence a child's use of the Internet at home (microsystem).

After examining Bronfenbrenner's (1979) original ecological systems theory and the extended and more recent bioecological model (2006), I adopted Bronfenbrenner's bioecological model as the theoretical underpinning for my study. This revised model closely discusses proximal processes, process-person-context-time relationships, children's active role in their own development, and the bidirectional relationships between systems. While Bronfenbrenner's bioecological model is considered an effective framework to explore how a person engages with their diverse environments and constructs their own identities and development in international and intercultural settings, many studies applied this model in their framework, but few of them have discussed how this model is related to their study in depth (Tong & An, 2024). In my study, I tried to give a more thorough explanation of how the bioecological model works with specific findings. In Chapter 4, I discuss each child's language and digital literacy experiences and developments in relation to key concepts from the bioecological model. In Chapter 5, while keeping the techno-subsystem (Johnson & Puplampu, 2008) and the bilingualism elements in mind, I examined the applicability of Bronfenbrenner's bioecological model in understanding bilingual/multilingual children's language development with touchscreen engagements in heritage family contexts.

2.5 Children's digital literacy

2.5.1 Definition of digital literacy

Since it is a trend that children use touchscreens more frequently in this digital age, this can be essential for them to master a range of abilities, including digital literacy skills (Chaudron et al., 2019). For children, developing digital literacy skills is vital for their future learning and development (Neumann, 2016). The definition of digital literacy is fundamental for conducting my study, since one of the stresses of my study is to explore the relationships between the young bilinguals' touchscreen-use activities at home and their bilingual literacy development through these activities.

Digital literacy can be defined as a "social practice that involves reading, writing and multimodal meaning-making through the use of a range of digital technologies (Marsh, 2019, p. 21)." In this definition, the multimodal meaning-making process refers to how a person communicate or makes sense of meanings via multiple modes, such as images, gestures, speech, music, and digital resources (Marsh, 2019). In other words, the multimodal meaning-making process involves not only the written or spoken languages but also some semiotic elements. Although it is closely tied to the usage of digital devices, digital literacy also includes several traditional print-based literacy abilities (Marsh, 2019). Therefore, both digital and non-digital skills are implicated and intertwined while discussing digital literacy.

Similarly, in a recent narrative review of parental mediation on children's family digital literacy practices (Soyoof et al., 2024), digital literacy skills are defined as the abilities to read, write, and communicate through the use of digital media. Beyond traditional reading and writing, digital literacy practices emphasise the interactive and multimodal

nature of digital communication (Soyoof et al., 2024). In other words, the diverse digital activities that adults and children engage with can be classified as digital literacy practices. For instance, when children engage with educational apps, they could read the text on the screen and listen to the audio instructions at the same time, then respond by touching the screen and receiving feedback via sound and animation (Soyoof et al., 2024).

As seen from the two definitions of digital literacy, it involves not only the traditional literacy skills such as reading and writing but also the meaning-making and communication achieved using multimodal digital technologies (Marsh, 2019). In my study, understanding children's digital literacy development during their home touchscreen activities is defined as exploring children's varied language practices and the multimodal meaning-making processes that involve several modes. To be more specific, not only the traditional literacy skills, such as reading and writing, during the young bilinguals' touchscreen activities are explored; their oral language experiences and how they practise languages during the multimodal touchscreen activities, through both interpersonal and non-human communications, are equally stressed.

2.5.2 Theories of digital literacy practices

Digital literacy is viewed as a social practice, which means that it is crucial to recognise literacy practices in particular cultural and social contexts (Marsh, 2016; Prinsloo, 2019). Dating back to 1995, in Street's New Literacies Studies (NLS) approach, literacy was viewed as a social practice influenced by a variety of social and cultural circumstances rather than a set of neutral skills (Street, 1995). NLS is deeply embedded in some recent studies exploring children's digital literacy practices (Marsh, 2016), because the focus of NLS is less on children's literacy practices in classical teaching environments and more in their everyday lives, for example, in home environments (Erstad & Gillen, 2019; Sefton-Green et al., 2016). However, among these studies, fewer long-term ethnographic studies have been conducted on younger children's digital literacy activities than those with teenagers (Poveda, 2019).

While recognising the significance of specific contexts in literacy studies, theories and findings on literacy practices in the digital age are built up and modified from certain traditional literacy models. Some research implemented Bill Green's (1988) 3D model of literacy into children's digital literacy practices (Marsh, 2016, 2019). According to Green's (1988) theory, literacy can be divided into three categories: operational, cultural, and critical. The operational dimension focuses on the language system and individuals' language competences in reading and writing adequately in different contexts (Green, 1988). The cultural dimension includes meaning-making skills and views literacy as a cultural practice (Green, 1988; Sefton-Green et al., 2016). The critical dimension emphasises the ability to question the texts encountered during literacy practice (Green, 1988). Although the 3D model was mainly about traditional print literacy practices, lately, this model has been applied to the study of literacy in the digital age (Marsh, 2019). For instance, the operational dimension can be used to classify the ability of using digital devices for communicative and meaning-making tasks (Marsh, 2019).

Furthermore, Colvert (2015) modified the 3D model to show how the meaning-making process is strongly tied to all three dimensions mentioned in the 3D model theory (Sefton-Green et al., 2016). She stated that the procedure of meaning-making involves the following four essential stages: design, production, dissemination, and reception (Colvert, 2015; Sefton-Green et al., 2016). An individual who wants to communicate (called a rhetor) needs to decide on the modes that he or she wants to use to convey the message in the design stage; next, in the production stage, the producer (who can

be the same person or another person than in the design stage) creates the text or artefact based on the chosen mode (Colvert, 2015). The message is then disseminated through a chosen media in the dissemination stage, and the audience who receives the message will respond with their own thoughts in the reception stage (Colvert, 2015; Sefton-Green et al., 2016). In Colvert's model, she adapted Green's 3D model and claimed that the three dimensions of Green's model are essential in the four stages of meaning-making and need to be included in this model (Colvert, 2015)

Colvert's model is not static but dynamic; it offers insights into understanding digital literacy by relating all prospects together, from the beginning intention of a rhetor to the final reception of a produced text or artefact (Sefton-Green et al., 2016). Having a clear overview of these theories on how children develop literacy is vital in understanding children's digital literacy practices with the use of touchscreens. For example, in a study examining children's (aged 0-5) adoption of touchscreen apps and their digital literacy skills in the UK (Marsh, 2016), Colvert's (2005) model is applied. In the operational dimension, it is reported that children were capable of navigating touchscreens and apps (e.g., open the *YouTube* app, scroll and find a video, then tap the correct button to play the video), and these skills are often associated with the reception of digital media texts (Marsh, 2016). Besides, the design and production during meaning-making processes were found in that study. According to parents' reports, 59% of children aged 5 or under in that study could use drawing apps (Marsh, 2016). In the process of drawing, children first choose the mode (drawing apps) to deliver a message in the design stage, and then in the production stage, they paint and create contents on the apps. However, the ability to disseminate texts was not commonly found in that age group (Marsh, 2016). Furthermore, it is suggested by some scholars that the critical dimension of children's digital literacy is less examined in the current studies (Kumpulainen & Gillen, 2019).

As the meaning-making processes and the children's digital literacy need to be understood within a specific environment, Marsh (2019) implemented part of Bronfenbrenner's (1979) ecological systems into Colvert's (2005) model. While putting Colvert's (2015) model in the middle, in Marsh's (2019) framework, children's digital literacy is studied within three layers, which are microsystem, mesosystem, and macrosystem. A child who practises digital literacy is put in the microsystem; the home, community, and societal environments around a child are listed in the mesosystem, and broader cultural, social, or national contexts are considered when studying a child's digital literacy at the macro level (Marsh, 2019). In my study, I adapted Marsh's (2019) framework (mostly using Colvert's model) and explored the applicability of Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006) to understand how bilingual children in my study practise digital literacy and develop languages through touchscreen engagements in their home environments.

2.5.3 Multimodality

It is essential to recognise the multimodal nature of digital texts to comprehend the meaning-making procedures in digital literacy activities (Erstad & Gillen, 2019). Multimodality is known as using several semiotic modes to create a symbolic message (Kress, 2001). A mode refers to a set of organised tools used in the meaning-making process, such as images, music, speech, sound effects, and movements (Jewitt & Kress, 2003). In children's daily digital literacy practices, they need to master various modes and develop both traditional and digital skills (Marsh, 2016; Poveda, 2019; Sefton-Green et al., 2016). In addition, digital literacy tools are designed to involve multimodal meaning-making (Erstad & Gillen, 2019). With the development of mobile devices like smartphones and touchscreens, digital literacy practices can also be seen as multimedia and multi-sensory (Sefton-Green et al., 2016). The reading and writing

processes are frequently supported in digital literacy practices by various modes, such as moving pictures and changing screen layouts (Dowdall, 2019). As discussed below, studies have been done to understand the multimodal processes in children's digital literacy practices.

For instance, in a two-year study conducted in both preschool classrooms and also home environments with 19 four-year-olds in the United States (Rowe & Miller, 2016), children used iPad and digital cameras to create multimodal digital literacy experiences, such as using iPad to create e-books with the photos they took, recording oral messages for their e-books, and drawing and writing with iPad. It was discovered that creating and using e-books that were integrated into touchscreens allowed children to practise words and images that move and change through the screen layouts during storytelling exercises (Rowe & Miller, 2016). Similarly, in a study conducted with 105 Turkish children (aged 5-7 years old) and their parents in Turkey (Ozturk & Ohi, 2022), children engaged frequently in many touchscreen activities with multimodal texts, such as watching educational videos, playing games, and video calling family members; they created diverse digital literacy experiences through the engagement with various multimodal modes. In another study conducted in both the home and kindergarten environment with a four-year-old girl in Malta (Farrugia & Busuttil, 2021), she engaged with a series of touchscreen activities at home to achieve both entertaining and educational goals; the findings indicated that this young girl developed her digital literacy through multimodal meaning-making processes, and she also combined her digital touchscreen use with physical toys to enrich her play experience with creativity (Farrugia & Busuttil, 2021).

The engagement with digital devices and the multimodal digital literacy activities lead to a new form of play, digital role play (Fleer, 2017). With the engagement of proper digital tools, children's conventional role play can be enlarged and enhanced; new types of imaginative play and narrative story-telling activities take place when children operate multimodal and multimedia screen contents (Fleer, 2017). In another study examining preschool children's digital role play through their engagement with touchscreen apps that did not have any fixed or predetermined goals inside these apps (McGlynn-Stewart et al., 2019), children formed digital role play and explored more on different identities with the help of multimodal designs in these apps. For instance, while using the photo and video functions that were embedded in apps, children imagined and acted in different roles, such as proficient teachers, photographers, and reporters; they were more enthusiastic in communicating or narrative storytelling through their engagement with multimedia resources (McGlynn-Stewart et al., 2019). However, the two studies mentioned here were all conducted within early childhood classrooms; in my study, I will examine potential digital role play through young bilinguals' home touchscreen activities.

Moreover, while embracing the multimodal feature of children's digital literacy activities, the traditional understanding of writing as mainly developing grammar and spelling skills is challenged; the concept of writing is argued to be enlarged to include speech, writing, and multimodal meaning-making processes using images, sound, and videos of traditional text (Dowdall, 2019). For instance, with the help of an online platform called *Talk-Time*, children demonstrated their oral skills with uploaded photos and videos; this activity fostered their writing from multimodal and social aspects since the children used these digital contexts to discuss and express their opinions in groups (Dowdall, 2019). As seen from the above studies, multimodal meaning-making processes are diverse and appear in different digital environments and digital literacy practices.

2.5.4 Predictors of digital literacy practices

As discussed in the previous sections, parents play a crucial role in facilitating children's digital literacy activities at home. Parental attitudes (Chaudron et al., 2019) and views (Ebbeck et al., 2016; Hinkley & McCann, 2018; Kumpulainen & Gillen, 2019; Nevski & Siibak, 2016), as well as their role as gatekeepers to mediate their children's access to digital devices and apps (Little, 2019; Ozturk & Ohi, 2022), are all vital predictors of a child's home digital literacy and multimodal practices. Besides parental role, there are also other predictors of children's home digital literacy practices.

In a study exploring children's (0–8-year-old) multimodal and digital literacy practices in China (Dong et al., 2022), the primary factors that influence the children's digital use include parental beliefs and mediations, children's age, family socioeconomic status, family locations, and domestic access to digital resources. However, in another study examining the digital literacy practices of 413 children's (0-8-year-old) in Canada after the pandemic (Fu et al., 2024), it is reported that while parents' attitudes and beliefs, the child's age, and the accessibility of home digital resources are critical predictors of children's digital literacy activities among these Canadian families, the financial status of these families is not a significant predictor of improving children's digital experiences.

Looking into both studies, despite parental attitudes and mediations, the child's age and their home digital resources are factors that can influence their digital literacy practices. As pointed out in Dong and her colleagues' (2022) study, the growth of age indicated that they could interact with digital devices better; older children were more likely to develop better digital literacy skills since their cognitive and physical abilities developed as they grew up. Similarly, it is believed that apart from the growing cognitive and physical functions, older children also have longer technological exposure to practice their digital literacy skills compared to the younger children (Fu et al., 2024). In addition, both studies found that the accessibility and types of home digital experiences are greatly related to children's digital literacy development (Dong et al., 2022; Fu et al., 2024). For example, children who are exposed to multiple digital devices at home may have more chances to explore and develop their digital literacy skills (Dong et al., 2022), and various digital activities, such as using educational apps with touchscreens and playing software games on computers, also provide different opportunities for children to develop their multiple digital literacy skills (Fu et al., 2024).

Moreover, the different findings on the predictors between the two studies indicate that children's home digital literacy and multimodal practices should be studied in specific environments (Fu et al., 2024) and embedded in real-life situations.

2.6 Bilingual children's digital literacy practices at home

For young bilinguals, developing heritage literacy is vital to becoming a fluent home language speaker (Eisenchlas et al., 2015). Family literacy research is crucial since children's primary literacy development occurs at home (J. Anderson et al., 2010), and children's emergent literacy practices should be strongly tied to particular cultural, historical, and ideological circumstances (Harrison & McTavish, 2018). The multiliteracies that pre-schoolers developed in the environment of their homes before entering school must be emphasised as more and more children begin kindergarten with a wide range of literacy skills (Harrison & McTavish, 2018). There are some previous studies on exploring children's bilingual digital literacy practices with the use of touchscreens.

Children's bilingual language and digital literacy skills could be enhanced through varied touchscreen activities. For example, in a case study involving German-English

bilingual children (ages 5-8) who were raised in Australia (Eisenchlas et al., 2016), the findings revealed that these young bilinguals strengthened their reading abilities in their native language (German) through the use of online games in a self-directed manner. In a case study (Harrison & McTavish, 2018) involving two Chinese (Cantonese)-English bilingual girls (aged 7 months and 22 months, respectively) who lived in Canada, the results suggested that the children learnt both Cantonese and English through not only independent interactions with touchscreens and smartphones but also the shared touchscreen activities with their family members (often the mother). While Cantonese is the primary language spoken at home, Ally's (the 22-month-old girl) touchscreen apps were switched to English mode by her mother; since her mother frequently used both Cantonese and English to say things when playing some gaming or story-telling apps together with Ally, Ally learnt vocabularies in both languages and developed her biliteracy and bilingual identity (Harrison & McTavish, 2018)

In a more recent study examining the home co-reading activity of digital books within four Maltese-English bilingual families in Malta (children aged 4-7 years old) (Mifsud et al., 2021), as an additional tool to traditional print books, the interactive and engaging features of e-books positively facilitate children's bilingual digital literacy practices. Some multimodal and multimedia designs, such as the interactive sound, animations, and responsive touchscreen settings in these e-books, encouraged the children to read a book repetitively since they enjoyed the multiple interactive contents during the reading (Mifsud et al., 2021). Similarly, in another study conducted with an Arab-English bilingual four-year-old girl (Aya) in Canada (Al Salmi & Gelir, 2024), the findings indicated that her engagement with a variety of digital devices, including smartphones, had largely influenced her bilingual development in Arabic and English. She used both languages when playing games and engaged with varied digital resources (Al Salmi & Gelir, 2024). In this case study, Aya's parents played a significant role in mediating her digital literacy practices, as they wanted Aya to maintain their home language Arabic; they were cautious on deciding on the contents that Aya was able to access and set up digital contents that Aya engaged with in Arabic (Al Salmi & Gelir, 2024).

Similar to Aya's case study, according to a study (Little, 2019) that investigated bilingual children's use of apps among heritage-language families in the UK context, the majority of parents in that study served as gatekeepers by providing touchscreen devices and choosing apps that they felt were appropriate for their children. Parents can encourage their children's multilingual and multicultural development by participating in activities using specific apps (Little, 2019). However, in this study, only 25% of the participating families used digital apps to facilitate their children's heritage language and literacy development; while there was a lack of app resources in some HLs, parents could also lack the awareness or technical skills to find and operate proper apps in their HL as well (Little, 2019).

However, for bilingual families, the use of digital technology does not always fit into the needs to support children's bilingual or HL development. In a study conducted to understand five Iranian mothers' opinions and their Persian-English bilingual children's (aged 6-7 years old) home digital literacy practices (Soyoof, 2022), children only used digital technologies in English at home instead of using both languages. In this study, the mothers expressed the importance of using digital devices to facilitate their children's English development, since developing English skills could be vital for various societal reasons, such as immigration and better education opportunities (Soyoof, 2022).

As seen from the above studies, like the predictors on children's digital literacy practices discussed in the previous sections, parents' attitudes and mediations have

vital influence on children's digital literacy practices in HL households as well (Al Salmi & Gelir, 2024; Little, 2019; Soyoof, 2022).

Moreover, in an ethnographic case study with a four-year-old Koryo-saram bilingual child who lived in South Korea in both home and preschool classroom settings (Yoon, 2023), it was found that the child used voice search technology to open *YouTube* and find the videos that he liked to watch. Although he spoke mostly Russian at home, he tried to use Korean to navigate the *YouTube* voice search several times; he managed to search for videos that he liked in Russian (e.g., *Among Us*) after a few attempts with different languages and pronunciations (Yoon, 2023). As illustrated in this study, using voice search is a vital part of this child's digital literacy activity and meaning-making processes (Yoon, 2023). He demonstrated his bilingual language capacities and language choices through this multimodal activity as well. He managed to search videos with his whole linguistic repertoire and changed the tone, pause, and pronunciations for the voice search tool to recognise (Yoon, 2023). As seen in this study, several digital voice assistants (DVAs) (Festerling & Siraj, 2022) such as *Alexa* and *Google Home* have become increasingly popular in children's family life, and these tools have made it easier for children to engage with internet-connected devices and navigate online contents more conveniently (Tong et al., 2022).

However, just like the case studies mentioned above, most case studies examining children's digital use and language development are on a small scale (Kumpulainen & Gillen, 2019). It should be kept in mind that these study findings cannot be overgeneralised into a wider context. These studies demonstrate that the digital literacy practices of young bilinguals are closely correlated to their interactions with touchscreens and apps, frequently in association with family support. However, it can be difficult to hear children's own voices during their meaning-making processes with the adoption of touchscreen apps, and children's own digital experiences remain less researched in the field of children's digital literacy practices (Harrison & McTavish, 2018; Kumpulainen & Gillen, 2019). More studies are needed to explore how children feel about using touchscreen apps and their literacy experiences, particularly within specific bilingual language contexts (Little, 2019).

2.7 Summary

Several studies have found that digital devices and touchscreens are prevalently and regularly integrated to children's daily lives (C. Chen et al., 2020; K. Choi et al., 2021; Chowsomchat et al., 2023; Dardanou et al., 2020; Day et al., 2024; Liszkai-Peres et al., 2024; F. L. Scott, 2022). In the UK context, a significant increase in children's touchscreen use was also found within five years (Ofcom, 2017, 2022). Studies have found that the COVID-19 pandemic has impact on the patterns of children's touchscreen use related to their digital literacy practices (Day et al., 2024; Soyoof et al., 2024; H. Sun et al., 2022).

Touchscreen devices are always portable, light in weight, and interactive in comparison to traditional screens (Pham & Lim, 2019). A lot of touchscreen apps aimed towards children have been developed and released in recent years (Livingstone et al., 2019). The interactive and multimodal features also made touchscreen devices potentially beneficial for enhancing children's digital literacy experiences (Al Salmi & Gelir, 2024; Mifsud et al., 2021). Some case studies have been done to explore how the multimodal nature (Erstad & Gillen, 2019) of touchscreens can facilitate young bilingual children's bilingual digital literacy practices (Farrugia & Busuttil, 2021; Mifsud et al., 2021; Ozturk & Ohi, 2022). In my study, touchscreen is defined as all kinds of touchscreen devices that a child can access at home, such as their parents' smartphones, iPads and other touchscreen tablets, and

touchscreen smart watches. Although the use of touchscreen in children's lives seemed a common phenomenon, baring the potential digital divide (Ofcom, 2022; Soyoof et al., 2024) in mind, the patterns of children's touchscreen use activities and choices are complex and need to be researched within specific sociocultural circumstances (Harrison & McTavish, 2018; Prinsloo, 2019).

For young HL speakers, many sociocultural factors could influence their bilingual language development (Fishman, 2001; Genesee, 2023; Uttley et al., 2013). For example, the beginning of formal education may decrease their HL practices and increase the use of dominant language to meet school educational goals (Collins & Toppelberg, 2021; Little, 2019). It is believed that a supportive language climate at home is vital in fostering their HL development (Ivanova, 2019; Park et al., 2012). One vital approach to examining young bilinguals' language practices at home is to study their Family Language Policy (FLP) within a specific environment (Curdt-Christiansen, 2009; Wilson, 2020). Studies have pointed out that although parents play a significant role in facilitating a child's HL development, both children's agency and parents' role should be valued and explored (Curdt-Christiansen, 2016; Roberts, 2023; Shen & Jiang, 2023).

Moreover, when looking into the bilingual children's language practices, translanguaging (Wei, 2018) is commonly found and discussed (Charamba, 2020; García & Otheguy, 2020; Stroupe et al., 2019). Although the concept of translanguaging is first introduced into the classroom (Stroupe et al., 2019) and more explored in pedagogy studies (Charamba, 2020; García & Otheguy, 2020; Kirsch, 2020), studies have also been done to understand bilingual children's translanguaging practices in home environments (Choi, 2024; Jung, 2022; Karpava et al., 2021; Song, 2016). Translanguaging should be viewed as a dynamic process in which bilingual children use their full and unique linguistic repertoire to meet communicative and meaning-making goals effectively and creatively (Wei, 2018). Children may also use their bilingual repertoire to communicate with people while engaging with technologies in family life (Roberts, 2023; Zhao & Flewitt, 2020), and translanguaging practices should be explored in the home environment.

For children's touchscreen experiences within a specific bilingual home environment, their language choices and digital experiences can be complicated as the young bilinguals have been exposed to varied languages since birth (Genesee, 2023). When examining these children's bilingual language choices during their touchscreen engagements in my study, adapting Marsh's (2019) definition of digital literacy, digital literacy is defined as the language use (oral and written) of both children and adults involved and the multimodal meaning-making processes during the Chinese-English bilingual child's engagement with touchscreen activities.

In addition, in every aspect of children's lives, the home environment and the role of parents are fundamental (Bronfenbrenner, 1994) and should be carefully considered when understanding children's home digital literacy activities (Morgade et al., 2019; Siibak & Nevski, 2019). Several studies have focused on the role of parental mediation on children's digital use in monolingual contexts (Nikken & Jansz, 2014; Scott, 2022; Zaman et al., 2016). In recent years, more studies have also been done within multilingual and HL family contexts to study children's digital literacy practices; the significant role of parents in their children's digital literacy experiences within bilingual/multilingual contexts is also emphasised (Al Salmi & Gelir, 2024; Haoning Mah et al., 2021; Little, 2019; Ozturk & Ohi, 2022; H. Sun et al., 2022; Yoon, 2023).

Besides, studies have identified several parental mediation (PM) strategies (Soyoof et al., 2024; Zaman et al., 2016) that are applied to manage and facilitate their children's

home digital activities. PM strategies could be influenced by many factors, such as parental attitudes, gender, socioeconomic and cultural backgrounds, digital skills (Kumpulainen & Gillen, 2019; Soyoof et al., 2024), and children's age (Nikken & Jansz, 2014; Soyoof et al., 2024). As seen from these studies, the PM strategies varied a lot in different family and social contexts. More studies should be done to examine how PM strategies influence bilingual children's home touchscreen use and digital literacy practices. Meanwhile, while some studies found that the co-use of digital devices fostered intensive parent-child interactions (Mifsud et al., 2021; Neumann, 2016; Sheehan et al., 2019; Strouse et al., 2018), other studies suggested opposite findings (Hiniker et al., 2020; Kildare & Middlemiss, 2017). The findings among these studies differ as they were mostly case studies within various settings. Therefore, in my study, parent-child interactions and PM need to be examined within specific family settings.

Identifying the research gap

After reviewing some existing literature related to my study topics above, potential research gaps and how my study design addresses these gaps are discussed below. First, scholars stated that more studies should be done to study children's digital literacy experiences and the specific skills they obtain when using multimodal digital devices (Kumpulainen & Gillen, 2019; Pereira et al., 2019). When looking into children's digital literacy practices, different predictors may influence their home digital literacy and multimodal practices; designing research within a specific environment is also vital (Fu et al., 2024). For children who speak HL, further research should be done to gain in-depth understandings of their touchscreen and digital literacy experiences within a specific ethnic group or community (Little, 2019). To bridge this gap, one of the main aims of my project is to investigate how young Chinese-English bilingual children develop their digital literacy while using touchscreen apps.

Second, when looking into the FLP of bilingual children and exploring their specific language choices, current studies pointed out that both children's agency and parent agency should be stressed and understood (Roberts, 2023; Shen & Jiang, 2023; Wilson, 2020). In my study, the child's voice and agency are considered throughout the whole research process. Besides, some scholars believe that for future FLP research, the awareness of different modes of language practices should be increased, and the HL practices in both traditional and digital forms, with or without interpersonal communications, should be stressed (Bose et al., 2023).

In addition, while several FLP studies have been done within the context of Chinese heritage families, many of them concentrated with older children (Huang & Liao, 2024; Shen & Jiang, 2021) or children with a wide age group (e.g., from 5 to 16 years old, or from 3.5 to 12 years old) (Curdt-Christiansen & Iwaniec, 2023; Tang & Zheng, 2023). Limited related studies have been done with younger children and a narrower age group within Chinese heritage families, especially in the UK context. My study design contributes to this research gap, as my participants were Chinese heritage families with 3 to 7-year-old children who were born and raised in England.

Third, previous studies pointed out that parents need support to acquire more knowledge on how to integrate technology at home and facilitate children's bilingual literacy development with appropriate digital resources (Hao, 2023; Ozturk & Ohi, 2022). In my study, I try to identify the specific challenges reported by the parents in each case and discuss some possible implications to help with this.

Chapter 3. Methodology

In this chapter, the details of my methodological design will be illustrated in the following order: my study aims and research questions, two methodological drives, the recruitment of participants, three data collection methods applied in my study, ways of transcribing data, data analysis methods, ethical considerations, and the researcher's reflexivity during the research process.

3.1 Aims and Research questions

My study aimed to understand Chinese heritage children's daily language experiences and explore their bilingual digital literacy practices through their home touchscreen use in England, with a focus on parents' role. Based on the aims of my study, the research questions are developed as below:

1. What is the general pattern of a young bilingual/multilingual child's home language choices?
2. How does a young bilingual/multilingual child develop their digital literacy through touchscreen activities?
3. What is the parental role in facilitating the child's bilingual/multilingual language development through touchscreen activities?

In my study, language development refers to the use and practise of both English and Chinese (and other heritage languages if applicable) and includes all intentional and incidental, formal and informal language practices of these bilingual children.

3.2 Methodological orientation

Bearing the research aims and questions in mind, I started thinking about the methodological orientation of my study design. Both the digital ethnography approach and the case study approach are my methodological drives. The two approaches are explained in the following sections, and how these two methodological approaches are combined in my study is also discussed.

3.2.1 Digital ethnography approach

Educational ethnography

The ethnographic approach is commonly applied in anthropology and various fields of research in social science; in the education field, educational ethnography is frequently used (Howard & Ali, 2016; Yon, 2003). Educational ethnography is a qualitative approach to investigating cultures and social phenomena within specific educational environments, often focusing on understanding the experiences of marginalised or social-minority groups in these settings (Yon, 2003). This approach has gone through an epistemological shift, from an objectivist to constructivist perspective (Yon, 2003), indicating that educational ethnography puts stress on the influences of personal experiences within different contexts in shaping cultures and knowledge (Howard & Ali, 2016). Contexts and spaces are viewed as part of a person's 'identity, sense of self, and their social world' (p. 14), and often playing a significant role in shaping personal experiences (Delamont, 2014). In other words, educational ethnography should not only include the traditional educational environments, such as school, but also places where a person comes from, such as their home and community environments.

Following this educational ethnography approach, researchers aim to understand the everyday lives of people while conducting thorough and comprehensive fieldwork. When choosing specific methods for conducting research, in-depth interviews,

observations, and fieldnotes are frequently used in education ethnography research (Hopson, 2016). Inspired by this approach, in my study, I took the opportunity to closely connect with my participating family groups over a period of time to understand their experiences of home touchscreen adoptions, the possible connections between the child's app-use activities and their language and literacy development, and the influences of parent-child interactions during these experiences. Additionally, as educational ethnography is often used to investigate educational issues in social-minority or marginalised communities (Howard & Ali, 2016), it aligns with my study aims of understanding the language and touchscreen experiences of Chinese migrant families in the UK context.

However, as my study was conducted during the COVID-19 pandemic, it was impossible to conduct face-to-face fieldwork. Therefore, I considered the digital ethnography approach and tried to find a suitable way to conduct my fieldwork. Details of the digital ethnography approach are discussed below.

Digital ethnography approach

As technology and media keep changing people's lives, the ethnographic approach has been evolving into new forms, and how ethnographers conduct the actual fieldwork also changes (Duggan, 2017). While most of the research methods of traditional ethnography can be applied in digital ethnography, this more recent approach gives researchers opportunities to communicate with participants without actually being present in the research fieldsite (Góralska, 2020). For example, with the help of digital technology, researchers can check participants' online social media platforms or observe their actions after gaining their consents (Pink et al., 2015).

Digital ethnography has frequently been used in anthropology and sociology research (Cocq & Liliequist, 2024); it is also an appropriate approach when exploring other research fields, such as Human Computer Interaction (HCI) or cultural and media studies (Pink et al., 2015). As with other ethnographic research, one main characteristic of digital ethnography is that it involves studying cultural practices and different forms of communication (Cocq & Liliequist, 2024). For instance, it is argued that digital family ethnography is an adaptable way to explore and reflect on people's living experiences with more depth, especially in transnational family contexts (Winarnita, 2019). By using different methods of digital family ethnography, such as observing the participants' online activities (e.g., posts on social media platforms) and holding interviews with family members together and separately, more comprehensive understandings of the participants' transnational family relationships are gained (Winarnita, 2019). In addition, when conducting research on family technology use, as home is an intimate and private environment, digital ethnography is a useful approach to help researchers understand their research topic without necessarily entering or bothering participants' everyday lives (Paay et al., 2022).

The digital ethnography approach may implement the 'digital' element in different ways. On the one hand, digital technologies can be used as tools to explore certain sociocultural fields; on the other hand, digital ethnography research may be conducted within a particular context that involves digital technologies; or combining both, using digital tools to explore social phenomena within a digital environment (Duggan, 2017). Following the constructivist perspective of educational ethnography (Yon, 2003), the epistemological underpinning of digital ethnography can be understood from a sociological perspective. This approach requires researchers' active engagement with participants within digital contexts for an extended period and constant reflections on the researchers' presence, to better understand their experiences or the research phenomena (Forberg & Schilt, 2023). Different from other qualitative research methods

that may not require the presence of researchers to collect data (e.g., discourse analysis), digital ethnography needs researchers to be present and actively engage in the fieldsite (Forberg & Schilt, 2023).

Aligned with the digital ethnography approach, the term 'fieldsite' in ethnographic studies is also developing. Several scholars have raised questions about the traditional definition of a 'fieldsite' as a static and single spot, and the boundaries of a 'fieldsite' have been expanded to the zones of networks online (Chambers, 2020; Góralska, 2020). Besides, some scholars have even enlarged the scope of a 'fieldsite' further (Chambers, 2020). For example, in the theories of autoethnography and netnography, a 'fieldsite' can be an imagined space that purely comes from the interactions on virtual platforms, or it can be interpreted as the ethnographers themselves (Hine, 2017). My fieldwork took place during the time when the COVID-19 pandemic was prevailing, and lots of restrictions and regulations limited the ethnographic fieldwork process. It is vital for researchers to examine the importance of using online 'fieldsites' to minimise the impact that COVID-19 had on qualitative ethnographic studies, such as the restraints on geographical fieldwork due to national-wide lockdowns (Chambers, 2020).

Based on the above understanding of the digital ethnography approach and the practical way of conducting my fieldwork during the COVID-19 pandemic, compared to the traditional ethnography approach, digital ethnography is the most suitable approach for my study. Within the situation of social-distancing policies caused by COVID-19, online interviews based on video tools are treated as substitutions for the traditional face-to-face interviews (Foley, 2021). As other researchers did during the pandemic, all ethnographic observations were carried out online as well (Góralska, 2020).

To successfully practise digital ethnography, some basic principles should be borne in mind. Pink and her colleagues' (2015) listed five main principles when conducting digital ethnography:

1) Multiplicity: Digital ethnographic study methods can be influenced by several factors, such as a particular theoretical framework, the different opinions of participants, stakeholders, and researchers, and how digital technology use is affected by infrastructures of people's daily lives.
2) Non-digital-centric-ness: Digital media should not be viewed as in the centre of a digital ethnography study; rather, it should be considered within a larger sociocultural context.
3) Openness: Digital ethnography is a flexible, cooperative, and cross-disciplinary approach, and the research process should be open-ended and be open to potential influences of the collaborative work of researchers, participants, and stakeholders.
4) Reflexivity: Researchers should be reflective on their role and consider how they interpret knowledge that is gained through their interactions with people and the research contexts. Potential ethical issues related to the digital research environment should be considered as well (Cocq & Liliequist, 2024; Góralska, 2020).
5) Unorthodox: Various forms of dissemination and interaction are valued in digital ethnography. For example, implementing photos and videos enriches the ways of illustrating findings alongside the written format, and it helps to convey emotions, relationships, and activities within the research environments.

It should be clarified that these five principles of digital ethnography are summarised according to experiences; it is not always necessary or practical for a specific study design to include all these principles (Pink et al., 2015). Considering the influence of the COVID-19 pandemic, some digital ethnographers believe it is an opportunity for

researchers to start doing digital ethnographic research by extending their fieldwork online, which means to implement digital elements into their original offline fieldwork design (Góralska, 2020). For my study design, the principles of doing digital ethnography were considered as outlined below.

Steps of applying digital ethnography approach in my study

First, I reflected on my positionality and researcher bias when I started designing the research aims and specific methods. While children's digital literacy practices through their touchscreen use are key to my study, I did not put it at the centre of my study design. Instead, I acknowledged the importance of understanding these bilingual/multilingual children's language choices in their family lives generally. For the fieldwork, interviews and observations are two commonly used data collection methods during digital ethnography studies (Cocq & Liliequist, 2024). Videos have been frequently used to collect ethnographic data in research (Duggan, 2017). The actual fieldwork may continue during the data analysis process, as using digital tools can make it hard to define whether the fieldwork has finished (Cocq & Liliequist, 2024). For example, the researcher may come back to the video recordings of the interviews or online materials when analysing the data or at a later stage. After the data analysis, the research findings are produced and disseminated (Cocq & Liliequist, 2024). Based on these understandings, I designed to hold the family interviews and the observation of parent-recorded videos of the children's digital activities online, so the fieldwork was less impacted by the COVID-19 pandemic and went more smoothly. The observation of parent-recorded videos of their children's touchscreen activities is one way to understand my research topic without stepping into the participants' home and disturbing their lives during pandemic.

Next, I embraced the openness and being flexible about the influences of different participants; I tried to follow their pace and respect their opinions. For example, I respect the participants' opinions on deciding the most appropriate time for interviews and recording videos. Then, I also reflected on how I as a researcher could inadvertently influence the research process (see section 3.8). Last but not least, the ethical issues related to conducting my fieldwork online were also carefully examined, and the details are written in section 3.7 on ethical considerations.

However, as digital ethnography requires an extended period of time (Forberg & Schilt, 2023), considering the time scale of my fieldwork and the usual length of ethnographic studies, I would say some cases in my study contained the digital ethnographical elements but might not necessarily be viewed as complete digital ethnography cases. Due to the real difficulty of recruitment and the influence of the COVID-19 pandemic, the actual length of the data collection period varied among these six cases, from around three to eight months.

3.2.2 Qualitative case study approach

As mentioned in the above section, understanding children's home touchscreen experiences and practices is one key element of my research aims. Considering the characteristics of digital ethnography and the practical way of conducting fieldwork during the COVID-19 pandemic, the digital ethnography approach is used as one methodological drive to guide my study design. Meanwhile, my study involved six families, research with each of the families was treated as a single case and conducted individually. Therefore, I adopted the qualitative case study approach as another of my methodological drives, based on the following considerations.

Similar to the digital ethnography approach, the case study approach can be used to

investigate various kinds of issues in many disciplines, such as in research of social work, political science, and health services (Gray, 2018). The case study approach is empirical in nature, and it explores social phenomena within real-life circumstances, and most of the time the lines between the research phenomena and the embedded contexts are blurred (Yin, 2009). In my study, I wanted to understand children's language choices and touchscreen adoptions within their family environment; the boundaries between my research topics and the actual research contexts are not clear.

Besides, the design of my study is qualitative in nature, and it follows the case study approach. The following characteristics of the qualitative case study approach further explain why my study fits into the qualitative case study approach. First, the researchers often apply a case study approach when they have limited control over the research settings or little ability to manage the research variables (Gray, 2018). In my design, the dominant setting to understand young bilinguals' touchscreen adoptions and language practices is their home environment. There are several research variables that are not easy to manage or generalise, such as multiple touchscreen use patterns of the participants and the varied home environments. To better explore the domestic touchscreen use experiences of children in detail, it is essential to apply the case study approach and acknowledge the varied situations in each family group in my study. Second, my study was on a small scale and recruited six families in total. It matches another feature of the case study approach: that the case study is used to collect the specified information from a narrow target group of people (Tight, 2010). Third, it is believed that case studies are useful when the researchers want to understand the relationships between the associated context and a particular phenomenon or people's experience (Gray, 2018). My study placed emphasis on seeking the connections between the young bilinguals'/multilinguals' touchscreen use at home and their bilingual/multilingual development, and the case study design can be helpful in achieving this goal.

When it comes to the epistemological underpinning of a qualitative case study approach, scholars argue that there are two types of epistemological stances for conducting case studies: realism and social constructivism (Priya, 2021). Realism aligns with the philosophical understanding of post-positivism, which believes that the actual world exists and is independent of how people perceive it (Priya, 2021; Williams, 2016). This epistemology can support explanatory case study research to understand the patterns and reasons behind existing social phenomena (Priya, 2021; Yin, 2014). Another epistemological underpinning for case study research is social constructivism. For constructivist researchers, they focus on the subjectivity of people, viewing certain social phenomena is related to people's expressions of their internal subjective feelings rather than the objective events that took place (Priya, 2021). In my study, the focus is more on understanding the children's and parents' perceptions of their language choices and touchscreen use; therefore, I think the constructivist epistemological stance works better for my study.

To successfully conduct a case study process, I adopted Yin's (2009) six-stage methodological framework. First, it is vital for researchers to have a clear thought on the research aims and form useful research questions as a first step, also known as the plan stage (Yin, 2009). Next, researchers can move to the second stage of design, implementing theories, identifying study design as single or multiple, holistic or embedded, and choosing data collection methods (Baškarada, 2014; Yin, 2009). The following stage is preparation; during this stage, researchers can practise and develop skills for conducting a case study, for example, developing information letters, running a pilot case study trial, and gaining participants' approvals (Yin, 2009). During this stage, researchers should be familiar with the theoretical and methodological knowledge related to the research (Baškarada, 2014). The next step is the collect

stage, researchers use all the data collection methods designed in the previous stages and conduct the actual case study (Yin, 2009). During this stage, multiple data collection methods, such as interviews, observations, and document analysis (Gray, 2018) should be combined. Among all the ways of collecting data, observational data collection methods are emphasised, as the observational materials (e.g. photos) may contain more information on the research topic (Baškarada, 2014; Yin, 2009). After collecting data, the next step is the analysis stage, specific data analysis methods are used to analyse each case or cross-case, and the theoretical propositions prepared in earlier stages may help the researchers to maintain the research focus and manage and interpret data (Baškarada, 2014). The final stage of the case study process is sharing, to disseminate the research findings to targeted audiences through specific forms (Yin, 2009).

One potential limitation of the case study approach is that the results of the study cannot be generalised into a larger group (Gray, 2018; Yin, 2009). Instead, the findings of the study are closely associated with the specified situations of the participants (Tight, 2010). But, considering the other side, this limitation can also be treated as an advantage since the specific life experiences and research topics within each case can be analysed thoroughly and understood in depth. In addition, like the digital ethnography approach, the case study approach also needs researchers to carefully consider the researcher's reflexivity and ethical issues (Priya, 2021) (see sections 3.7 and 3.8).

Steps of applying the case study approach in my study

In my study, at the plan stage, I developed and modified my research aims and questions based on my initial research interests, reflections on my positionality, and the research needs in the related fields. At the design stage, I read through several frequently used research methods of case study and chose appropriate methods for my data collection and analysis. As my study was designed to understand the experiences of children's home language choices and their touchscreen use, I applied Bronfenbrenner's bioecological model (2006) as the theoretical framework to guide my case study design. After choosing theory and designing the research methods, at the prepare stage, I created the information letters, gained ethical approvals, recruited participants, and gained their consent. Meanwhile, during this stage, I also developed my study as a multiple case study. The reasons for designing a multiple case study are explained below.

I first treated every family group as a case because each family's touchscreen use habits and language choices are different. Therefore, the whole study consists of multiple case studies (six cases in total). Different from a single case study, the design of multiple case studies offers a chance for the researchers to investigate the differences and similarities among these varied cases, and it helps the researchers to analyse data not only in an individual case but also across multiple cases (Baxter & Jack, 2015; Gustafsson, 2017). The multiple case study approach suits my research better since it helps me to explore not only the young bilinguals' home touchscreen adoption and language use in a single case, but also offers the opportunity for me to compare the similarities and differences of the children's home touchscreen use and literacy experiences in several cases (Gray, 2018).

At the collect stage, I used online family interviews, parent-recorded videos, and created mediagrams to collect data with each family. Details about the data collection methods are discussed in section 3.4. When it comes to the analysis and share stage, the individual case study analysis is written in Chapter 4, and the cross-case analysis is written in Chapter 5. The application of Bronfenbrenner's bioecological model (2006)

in my study is discussed in these two chapters.

3.2.3 Combining the two approaches in my study

In the above two sections, I thoroughly explained both the digital ethnography approach and the case study approach. I also illustrated the specific steps of using these two approaches in guiding my study process. As seen from the above two sections, these two methodological approaches share some similarities and have their unique strengths individually.

Both approaches can be used to investigate social phenomena and people's experiences in real-life contexts (Cocq & Liliequist, 2024; Yin, 2009). When looking into the methodological frameworks of the two approaches, they share similar research processes, as the steps of each approach that I demonstrated in the above two sections. For example, both approaches begin with identifying research aims and forming research questions (Cocq & Liliequist, 2024; Yin, 2009). For the data collection methods, both approaches share similar methods (e.g., interviews and observations) and put stress on the potential benefits of collecting visual data (e.g., photos and videos) (Baškarada, 2014; Pink et al., 2015; Yin, 2009). Another feature of digital ethnography is that this approach emphasises the active interactions between researchers and the participants for a period of time (Forberg & Schilt, 2023). Both approaches value the careful consideration of the researcher's reflexivity (Pink et al., 2015; Priya, 2021).

Moreover, when looking into the unique strengths of each approach, they complemented each other; hence, combining these two approaches facilitated the investigation of my research questions. The primary strength of digital ethnography is its flexibility and openness (Cocq & Liliequist, 2024; Pink et al., 2015). Considering the evolving definition of 'fieldsite' as relating to not only geographical but also virtual environments (Chambers, 2020; Góralska, 2020), a digital ethnography approach aided my study design, especially before and during my fieldwork. Digital ethnography provides me with practical online research methods to help my fieldwork go smoothly, when offline fieldwork was impossible to carry out during the COVID-19 pandemic. In addition, as two of my research questions were related to the bilingual/multilingual children's touchscreen use (one about their digital literacy practices and one about parents' roles in these activities), digital ethnography helps me better answer these questions as it is an approach to investigate both personal experiences within the digital environments and through digital platforms (Duggan, 2017).

When looking into the strengths of the case study approach, developing a theoretical perspective for the study at the design stage is necessary and helpful (Gray, 2018; Yin, 2009). Compared to the flexible nature of digital ethnography, selecting a theoretical framework to guide my study design was one of the key benefits of implementing the case study approach. A theory can not only guide the study design from the design stage, but also facilitates the following stages of collecting, analysing, and presenting data (Yin, 2009). In my study, Bronfenbrenner's bioecological model (2006) of human development worked as the theoretical framework. Applying this theory helped me maintain my research focus on children's language developments and touchscreen practices; it also facilitated the discussion of my research findings and a better understanding of my research questions. Meanwhile, the case study approach guided me to design my study as multiple case studies (Gray, 2018). As my study involved six individual families, applying a multiple case study approach facilitated the in-depth understanding of both the language and touchscreen experiences in each case and cross these cases (Baxter & Jack, 2015; Gustafsson, 2017). Therefore, this case study approach also helps me gain an in-depth understanding of my research questions

about children's language and touchscreen experiences within their real-life home environments (Yin, 2009). In addition, in case study design, the written reports of each case or cross-cases should reflect the chosen theory (Gray, 2018; Yin, 2014). While the theoretical framework shed light on understanding a child's proximal processes of developing languages and engaging with touchscreens, my findings from each case also contributed to enriching the application of Bronfenbrenner's bioecological model (2006) on language development within specific bilingual/multilingual contexts.

From the above discussion, digital ethnography and multiple case study approaches are effectively combined in my study. While the case study approach guided me to choose an appropriate theory to guide my study design and structure my findings, digital ethnography offered me flexible research methods to conduct my actual fieldwork during the COVID-19 pandemic and understand the touchscreen activities. Both approaches reminded me of the importance of reflecting on my positionality and the researcher's bias during my study. Applying a digital ethnography approach offered me opportunities to gain knowledge of children's touchscreen activities in real-life contexts in more depth. Embedding the case study approach facilitates in-depth understandings of children's language choices and touchscreen use within specific sociocultural environments in each family. The combination of the strengths of both approaches helped me to conduct my study in a thoughtful way and obtain a more comprehensive understanding of my research questions.

3.3 Participants

3.3.1 Recruitment

The original plan was to recruit six to eight Chinese-English bilingual families who live in England. The age range of ideal child participants should be between 3 and 7 years old. At least one of the parents in the family can speak the heritage language, Chinese. Meanwhile, the children should have access to touchscreen devices (e.g., iPads, mobile phones) at home in their daily lives. The choice of the age range of children aims to make the participant sample more diverse. 3-7-year-old children cover different developmental stages; some are in preschool, while others have started their school journeys. Besides, the start of school usually brings constant changes in children's literacy development and the maintenance of their home languages (Nuñez, 2019).

With careful planning, I had several channels to recruit potential participants: contacting a community school, via personal networks using the snowball method (Noy, 2008), and social media posts. First, I tried to use the channel of a community school in the north of England to start the recruiting process, since this heritage language school has a social network that may cover potential participant groups (Chinese-English bilingual families in England). Two of the families were recruited through this method.

Then, while waiting for the responses from this community school, I began to use the snowball method (Noy, 2008) as a second channel to recruit potential participants. Three families were successfully recruited through this channel. Besides, I also used social platforms as the third recruiting channel. I posted the recruiting information for my study on several social platforms and successfully recruited one family through one social platform.

One thing that needs to be clarified is that the recruitment was not a smooth thing, and it took several months to find all the families to participate in my study. Except for two families who opted out due to changing life circumstances, six families were successfully recruited, and they participated in the whole data collection and analysis

period.

3.3.2 Demographics

To begin with, the demographics of the six participating families are listed below for a general overview of each case.

Child's name	Child's Gender	Child's age	Parents	Family members who the child live with	Family languages	Education background
Feifei	Female	3	Chinese father and Indonesian mother	The parents	Chinese Bahasa Indonesia English	Started going to nursery by the time of the first interview
Mango	Male	6 (turned 7)	Chinese parents	The parents	Chinese English French (as Mango claimed in his language portraits)	Finished the primary school journey and entered a private junior school by the time of the second interview
Moe	Female	3	British father and Chinese mother	The parents and her little sister (1)	English Chinese	Not started going to nursery/school
Tutu	Female	3 (turned 4)	Chinese parents	The parents and her little brother (1); her grandparents came to visit occasionally	Chinese English	Started going to nursery by the time of the second interview
Vicky	Female	5	Chinese parents	The parents and her elder brother (9)	Chinese English	Finished the reception year and started Year 1 by the time of the second interview
Wangwang	Male	4	Malaysian father and	The parents; his Chinese grandmother	Chinese (Mandarin) English	Finished the nursery journey and

	Chinese mother	came to visit occasionally	Chinese varieties (Hakka, vernacular/Bai hua, and Cantonese)	started the reception year by the time of the first interview

Table 1 Participants' demographics

3.3.3 Children's agency and adult-centric models of research investigations

As the demographics above indicate, my study involved both parents and children. Before moving to the sections of specific data collection and analysis methods, I want to briefly reflect on the relationship between children's agency (Petersen, 2015) and adult-centric models of research investigations. The concept of adult-centric refers to an implicit mindset that is deeply rooted in various parts of society, which shapes the stereotypes of children in education, sociology, childcare policies, and research investigations (Biswas et al., 2024; Goode, 1986). For example, a typical adult-centric model is 'child as an empty box', in which children are viewed as lacking experience or skills and need to receive knowledge from adults (Goode, 1986). Another example is the model of 'child without agency', which emphasises the influence of external environments on a child's development and views children as passive receivers (Burrell & Morgan 1979). In adult-centric research methodology, adults' power outweighs children's power, and the associated attitudes, research methods, and actions are harmful and disrespect children's rights (Liebel et al., 2023). As discussed in section 2.1.4, children's rights and agency should be highly valued. Children should be viewed as active agents who have the capacity to intentionally act and influence their own childhood (Garcia-Quiroga & Agoglia, 2020; Petersen, 2015). Researchers should assess adult-centric bias and promote children's rights and agency during research investigations within specific contexts (Biswas et al., 2024).

Based on the above understandings, many recent research investigations conducted with children follow rights-based approaches to actively involve children's voices and participation (Biswas et al., 2024; Garcia-Quiroga & Agoglia, 2020). Although my study was not child-led research that children lead the whole study design and fieldwork (Tisdall et al., 2023), children's agency was carefully considered and embedded throughout my methodology design. First, I carefully examined the ethical considerations when doing research with young children, to protect them while respecting their agency (see sections 3.7.1 and 3.7.2). Then, after gaining children's assent and parents' consent, I managed to actively promote children's agency during the data collection. Children's responses and actions are closely associated with their communications with surrounding people and environments (Sairanen et al., 2020). During adult-child interactions, conducting child-centred and child-led activities is a way to promote children's agency (Sairanen et al., 2020). Valuing children's agency in a study does not equal the idea of making the young participant isolated or not providing any help/scaffolding during the research. Rather, the researcher should make efforts to communicate and reflect together with the children, to value the young people's power to present their agency and opinions, and to create more in-depth understandings based on both the adults and the children's knowledge and abilities (Little & Little, 2022). In my study, family interviews (see section 3.4.1) and co-viewing of parent-recorded videos (see section 3.4.3), which include both the parent(s) and child(ren), were held. The natural interactions between parents and children were welcomed, and I also tried to communicate more with the children and encourage them to express their thoughts. I also conducted the language portrait activity with each child to encourage them to express more ideas about languages (see section 3.4.2). During the data analysis, I paid attention to the influence of children's agency and individual

characteristics when discussing their specific language choices and touchscreen activities (see chapters 4 and 5). I also reflected on my positionality as an adult and a researcher during the whole study (see section 3.8).

3.4 Data collection methods

3.4.1 Family interviews

The necessity of family interviews

Interviewing is a frequently used measure for researchers to learn about individuals' daily lives and the ways they interpret their experiences (Gray, 2018). When doing multilingual research with children, family interviews often play an essential role in adding more depth to the data collection (Little, 2024; Tsikata & Darkwah, 2014). During family interviews, the voices of both parents and children are equally respected, and the input from the parents or the children may help others recall relevant memories and share thoughts and emotions.

The aims of my study are to understand young Chinese-English bilinguals' language and touchscreen uses at home, with a focus on parents' roles. Therefore, family interviews are suitable for my data collection because the parent and the child in each family group were designed to be interviewed together during a series of interviews. Even though the children in my study, aged from 3 to 7 years old, were young, their feelings and ideas should be valued (Flewitt, 2019), since children's rights and agency should be acknowledged (Sairanen et al., 2020). The child's assent was gained every time before and during the interviews (more on children's assent will be explained in section 3.7).

The impact of Covid on social and online interviewing

Under the impact of COVID-19, qualitative researchers face new challenges and constant changes in conducting research on people's real-life experiences (Lobe et al., 2020). When doing qualitative research, both the researchers and the participants need to be accustomed to the changes caused by COVID-19 for the foreseeable future (Foley, 2021; Hill et al., 2021). For example, the restrictions of social distancing cut off various sorts of face-to-face meetings (Lobe et al., 2020). Therefore, more online video interviews are developing to replace the common offline interviews due to the pandemic (Foley, 2021; Hill et al., 2021; Nyashanu et al., 2020). The use of video conferencing platforms like *Microsoft Teams*, *Skype*, and *Zoom,* makes it possible to conduct interviews when the researcher and the participants are not able to meet in person while keeping the feature of seeing each other's faces (Foley, 2021). Moreover, the online video interview is not only an alternative to a traditional in-person interview (Foley, 2021). It may also attract people who were not willing to participate in offline personal meetings, since they may feel safer in the virtual environment with more anonymity (Upadhyay & Lipkovich, 2020).

For my study, the family interviews need to be held with children (3–7 years old) who are considered as vulnerable groups (see more on section 3.7.1). When I submitted the ethical application for my study and before starting the data collection (which was January 2022), the Omicron variant was spreading around the UK and worldwide with unprecedented speed and intensity. Therefore, my study's recruitment and family interviews were all designed to take place online for social distancing and to protect the safety of potential participants and myself.

However, the potential drawbacks of conducting online interviews should also not be ignored. When doing online interviews, plenty of essential ethical concerns should be borne in mind, just as when doing in-person interviews (Lobe et al., 2020). More about

the ethical considerations of online interviews in my study will be explained later in section 3.7. For online interviews, it leads to more considerations on the issues of data privacy, security, and confidentiality (Foley, 2021). The researchers must pay special attention to any potential data leakage that online recordings may cause. For instance, the researcher needs to investigate more on data protection policies and security issues (Lobe et al., 2020). For my study, *Google Meet* was used to conduct online interviews with the family and record the interviews. I used my university *Google Meet* account instead of my personal account when conducting the online interviews. Three interviews were held with each family; the length of each interview and data collection period with each family were different, according to their schedules and recruitment timelines. The details of the interview length and arrangement with each family are listed in the individual case analysis of each family (see Chapter 4).

Online family interview processes

As explained above, all the family interviews in my study were held online via *Google Meet*; each interview involved both the parent(s) and the child(ren) in each family group. The processes of conducting online family interviews are illustrated below:

After gaining the parents' signed consent form, I explained the language portrait (LP) activity (see section 3.4.2) and the parent-recorded video activity (see section 3.4.3) in advance with the parents and sent them the needed materials (e.g., a body silhouette picture) before conducting any interviews. When the parents understood both activities and had no questions, I settled on a time with the parents and their children for the first interview. Before the first interview, I checked if the families had access to printers at home (if not, I would send the printed LP material through the post), and all the families had access to printers at home. The parent participants were asked to prepare a printed version of the body silhouette and some coloured pens for the child before the first interview. Meanwhile, I also chatted with the parents and children before the interviews, asking for their opinions of the languages (English, Chinese, or both) that they preferred me to use during interviews. I was also flexible when talking to the children during the interview; sometimes I would change the languages from time to time according to their responses. I asked for the child's assent each time before and during the interviews. The first interview involved two sections: an ice-breaking LP activity and a semi-structured interview with both the parent and the child. The follow-up questions related to the LP activity were asked if the child had managed to finish that activity. After that, other semi-structured questions were asked to gain basic knowledge about the child's daily language use and home touchscreen adoption. At the end of the first interview, I reminded the parents about recording video clips of their child's home touchscreen use every four to six weeks.

The other two interviews were held with each family group after receiving the videos recorded by the parents. During these interviews, the child and the parent(s) were encouraged to freely comment on the content of the parent-recorded videos. I also asked some questions stemming from the video data content during the interviews with the families. All the family interviews in my study were designed as semi-structured. Semi-structured interviews offer opportunities for the participants to chat openly about a theme and may accelerate interesting aspects of the research topic that were not designed at the beginning (Gray, 2018). At the end of each interview (except the first one), the mediagrams (explained in section 3.4.4) of the child's touchscreen and language use map were discussed with the family. They were welcomed to make suggestions and amend mediagrams through discussions.

3.4.2 Language portrait (LP)

LP in researching with children

The language portrait (LP) is designed to make each language visualised through drawing; it was first introduced to European classrooms in the early 1990s, where the children were from multiple language backgrounds due to massive migration and mobility of labour (Busch, 2006). To paint a LP, the participants are given a blank body silhouette image first; they need to pick different colours to represent the different languages they speak, then put the colours on varied body parts (Busch, 2018). By visualising the participants' linguistic repertoires in a biographical way, the LP activity is argued to be effective in helping children to demonstrate their diverse language backgrounds and also their understandings of language identities (Soares et al., 2020).

However, similar to written and oral contexts, the visualised image cannot tell the whole story of children's perceptions about languages on its own (Soares et al., 2020). To make up for this shortcoming of LP and gain more knowledge on the participant's entire linguistic repertoire, several studies apply LP activity with follow-up interviews and other data collection methods (Busch, 2021; Soares et al., 2020). For example, in a study exploring multilingual pupils' linguistic repertoires in a north-western province of the Netherlands (Soares et al., 2020), 570 language portraits were drawn by pupils aged from 6 to 13 years old; written descriptions and selective interviews were also conducted with the participants. In this study, compared to the language background survey contents, the children tended to demonstrate more diverse languages, including imaginary languages that they invented or liked (e.g., vampire language), during the LP activity (Soares et al., 2020). Besides, another finding from the LP activity and the following semi-structured interview was that the pupils chose colours for different languages by following certain patterns (Soares et al., 2020). For instance, they may choose a colour for a language from the country flag or based on their relevant personal experiences or memories (Soares et al., 2020). Similarly, in a workshop held with secondary school children in Australia (Busch, 2021), the participants reflected on their multilingual communication and language experiences during the LP activity. It is argued that the participants demonstrated more diversity in their linguistic repertoires when less structured instructions from the LP are given (Busch, 2021).

The suitability of LP in early years studies

The suitability of LP in research with children in the preschool or reception year needs more discussion. For preschool children, they may find it difficult to understand or conduct the LP activity as smoothly as older children. Only a few studies (Fashanu et al., 2020; Tatham-Fashanu, 2021) have applied LP with preschool-aged children, it is questionable whether children can understand the constructions of the LP activity as the cognition development stage varies from early years to older ages. For example, it is easy for older children to understand the relationship of picking a colour to represent a language, but pre-schoolers may raise questions about why a colour can represent a language. Similar difficulties appeared in my study; the related findings will be discussed in the section on LP activity in each individual case study (see Chapter 4).

However, it does not mean that applying the LP activity is not suitable for early childhood studies; the potential strengths of this activity in language research with children should also be valued. First, the benefits of conducting LP with older children can still apply to younger children. It is argued that the LP activity is useful to help children start thinking and talking about their knowledge of languages, and it follows another form of meaning-making logic instead of the oral form (Busch, 2018). Besides, for children, exercise-based activities generate less stress and more interest than conventional interviews, requiring more in-time verbal responses (Tatham-Fashanu, 2021).

In my study, the child participants were aged 3 to 7 years old, which covers a wide

range of developmental stages in the early years. Therefore, I needed to find more practical ways to support preschool-aged young bilinguals in conducting this activity. In a study aiming to understand if the educational framework in England marginalises the 4-5-year-old children's multilingual practices (Fashanu et al., 2020), cartoon strips were used to help the children understand the activities they participated in, and the children were asked to do the LP activity in small groups. Small groups can be helpful for children to understand more about this activity since they can discuss and share thoughts with each other. However, in my study, the LP activity for young bilinguals was designed to take place at home with parents accompanying. It may not be practical to let the children do the activity in small groups since each family group is a separate case. In another study conducted with French-English families in the UK, where the youngest participants were 6 years old (Wilson, 2020), clear step-by-step instructions were given to the young bilinguals at home in each family. In addition, how the children verbally interpreted their LPs was recorded and transcribed word-for-word during the data transcription, and plenty of information from the LP recordings was found during the data analysis (Wilson, 2020). These studies and their findings informed the design of the LP activity for my own research.

LP design in my study

Based on the relevant former studies mentioned above, I implemented the LP activity in my research in the following way. The LP activity is applied as an ice-breaking activity with the 3 to 7-year-old bilinguals, since it helps the young participants start to think about the languages around them and open a conversation with the researcher (Busch, 2018). In addition, considering the LP as part of the first online family interview in my study, I communicated with parents about this activity and asked for their assistance before conducting the activity with children. I first explained the LP activity to the parents separately and sent them the body silhouette picture. The parents helped to print the body silhouette out for their children and prepare several colour pens for the activity. Although the LP was initially designed as part of the first family interview, I also offered flexible options to let the parents conduct the LP with their children before the first family interview because I valued the participants' ideas and suggestions. For example, during the communication with Mango's mother, she expressed that she thought it could be better to let her conduct the LP activity with her son instead of letting me introduce it during the online interview. Because she thought this activity was complicated, her son might not be able to give me timely responses. Compared to me as a stranger and researcher, the mother knew better how to give instructions about the activity in a way that her son can understand (Mayall, 2008). Therefore, after making sure that she understood the activity clearly, I let her conduct the LP with her son separately as she wished. She then sent the recorded video of this activity to me. For the other participants, I also explained the LP activity design to the parents at first and gave them the freedom to either choose to conduct the activity during the first family interview with me or to conduct it without my presence before the first interview.

For the participants who chose to have the LP activity during the first family interview with me, the following instructions were given to the child, and flexible questions may be asked to help the child get to the point of this activity:

- *Let's play a little game together! Can you show me the picture mommy/daddy printed for you?*
- *Imagine this little boy/girl on the paper is you, and this is your body.*
- *First, do you know how many languages you can speak? Which languages do you speak?*
- *Can you pick different colours for the languages you speak? One colour for one language? Which languages do you use when talking to mommy and daddy, friends, or teachers?*

- *Can you remind me what colour you chose for Chinese/English?*
- *You can then paint your body now. Think about the languages we talked about; where do you think they should be painted? Anywhere on your body?*
- *Can you tell me a bit more about your painting?*

As mentioned before, there were some realistic difficulties encountered in my study fieldwork in different cases of each family. Applying LP activities to different children can lead to varied conversations. Some of the children showed clear understandings about the languages they spoke, while others were less clear about this topic. More details will be discussed in Chapter 4 and Chapter 5.

3.4.3 Parent-recorded videos

Parent-recorded videos in early years research

Over the last few years, video recordings have been applied in the field of early childhood research with children, and it is argued to be a useful method (Blazek & Hraňová, 2012; Wilkinson et al., 2020). Differentiating from traditional questionnaires, observations, and interviews, the recording of videos in preschool studies helps the researcher observe the participants' authentic daily routines (Baranek et al., 2005). Besides, it makes the researcher sensitive enough to grasp multiple details that may be underestimated when using other methods (Derry et al., 2010). Besides, in qualitative research, analysing videos is believed to be a beneficial way to help with the research design that aims at understanding and exploring the participants' life experiences, identities, and opinions (Knoblauch & Schnettler, 2012; Yates, 2010).

Moreover, since video cameras have become more and more popular and available in people's daily lives, introducing videos into the research design of some home studies gives the participants opportunities to shoot their own videos at home (Stephen et al., 2013; Wilkinson et al., 2020). For example, in Wilkinson and her colleagues' (2020) study exploring the healthcare demands of children, parent-recorded videos (without the researchers being at the scene) were used as a dominant way to collect data, and plenty of useful instructions about parent-recorded videos can be found in that study. The parent-recorded videos provide fruitful material for the participants, such as facial expressions, body gestures, and voice tones (Wilkinson et al., 2020). Similarly, in another study exploring children's home engagement with digital toys and other digital tools (Stephen et al., 2013), parent-recorded videos were also applied to support the data collection of the children's daily use of technology at home. It is believed that the parent-recorded videos offered a chance for the researchers to observe the participants' daily lives and their private communications, since the presence of the researcher changes the participants' natural daily interactions into public ones (Stephen et al., 2013). Besides, parent-recording also offered a lens to understand the participants' behaviours from different angles and in more depth, because some emotions (especially negative ones) or behaviours of the children tended to be hidden when an outsider presents at their home (Stephen et al., 2013).

However, it is crucial to acknowledge that the video-recording data itself is incomplete (Wilkinson et al., 2020). For example, some parent-recorded videos may only show the information that the parents want the others to see; they can be modified by the parents and are only part of a whole story (Wilkinson et al., 2020). Therefore, although parent-recorded videos have their own unique beneficial features, this method should be implemented with other data collection methods rather than used solely.

Video-cued ethnography (VCE) and my study design

When designing the parent-recorded videos and the following family interviews in my study, studies that applied the video-cued ethnography method (Adair & Kurban, 2019;

Liu, 2019; Tobin, 2019) also gave me hints and inspirations. VCE is a research method of making films with the participants "across geographic, cultural, linguistic, national, ethnic, and economic spaces (Adair & Kurban, 2019, p. 245)". It is popular in early childhood education research (Adair & Kurban, 2019; Liu, 2019; Tobin, 2019). The initial use of VCE was filming in a school context and demonstrating the recordings to the people involved in the films (the teachers, children, and other family members) to help them find the cultural norms and exclusions in their routines (Adair & Kurban, 2019; Tobin, 2019). The films recorded are often not the main data; they stimulate the participants' reflections and lead to more discussions relating to the research topic (Adair & Kurban, 2019). Although VCE is not frequently used in early years home studies, one feature of this method inspired my study design. By applying VCE to the research, the researchers encouraged different participants to interpret the same information from different perspectives (Adair & Kurban, 2019; Liu, 2019). Meanwhile, using videos as a cue for the following interviews helps the researchers value children's voices (Cutter-Mackenzie et al., 2015; Liu, 2019). For example, in a study investigating children's daily lives in a first-year Chinese preschool classroom (Liu, 2019), the researcher found that most of the children enjoyed appearing in the films and looking at themselves in the videos, and they were active and kept asking reflective questions when watching the videos.

Being inspired by the VCE, in my study design, I used the parent-recorded videos as a cue in the family interviews. On the one hand, these parent-recorded videos offer a different perspective on understanding the children's home language practices during their touchscreen activities compared to the family interviews. On the other hand, the parents and the children are welcome to interpret the parent-recorded video data during the interviews, and I want to encourage the children to express more thoughts relating to the research topics when watching these videos.

Parent-recorded videos in my study

Understanding the benefits and potential drawbacks of parent-recorded videos, I implemented the parent-recorded videos as part of my data collection design. Family interviews and mediagrams were applied together with the parent-recorded videos in the data collection period to form data triangulation.

In my study, I first explained the details of the parent-recorded videos to the parents before the first interview. I gave them clear instructions about how to record the video clips through online calls or text messages. The parents were asked to record 2-4 videos of their children's home touchscreen use activities during the intervals of interviews; the total length of the videos each time should be at least two minutes. They could use their mobile phones or any devices (for example, cameras) they wanted to use to record the videos. The parents were asked to send the video clips to me. The parents could choose the contents that they wanted to record, so long as the recordings were related to their children's touchscreen use activities at home. After receiving the videos each time, I first transcribed the video data (see section 3.5) and then arranged a time for a following interview with the family group. In my opinion, discussing the content of parent-recorded videos thoroughly with the participants helps reduce researcher bias or avoid being too subjective when interpreting the data. In addition, it also provides the participants with more opportunities to share their thoughts and reflect on the data they create together in more depth.

As for the time cycle of collecting the parent-recorded video data, the initial plan was to ask the parents to send me recorded videos every four to six weeks. However, practical difficulties extended this timeline. For example, some parents became extremely busy and spent less time at home with their children. Meanwhile, some families chose to spend most of their family time outdoors during the weekend to enjoy

spring and summer, which made recording the children's home touchscreen use even harder. Therefore, I asked the parents to record the video clips by sending them reminder messages, but I totally understood their real-life situations. So, I did not want to force them to record anything; instead, I gave the parents the freedom to decide when they could record and send me videos. The varied situations in different families led to different time lengths for which they sent me videos. I tried to respect the different pace of each family and followed the time schedule we negotiated individually with each family.

3.4.4 Mediagrams

Mediagrams design of young bilinguals' touchscreen use maps

In my study, the thought of visualising the touchscreen use patterns of the young participants is motivated by the creation of mediagrams in Lexander and Androutsopoulos's (2021) study. In their study about understanding the "mediational repertoires" (p. 2) with multilingual families in Norway, mediagrams are applied for visualising the multilingual families' language and media choices in their communication with different interlocutors (Lexander & Androutsopoulos, 2021) The mediational repertoire in that study includes multiple language patterns (e.g., spoken, written languages) and plenty of graphical and multimedia symbols (e.g., videos, gifs), depending on the usage of certain apps (Lexander & Androutsopoulos, 2021). Specifically, to make a mediagram, "a core informant" (p. 6) is put at the centre and the "relevant partners" (p. 6) are placed around the centre (Lexander & Androutsopoulos, 2021). Different colours and styles of lines are used to represent multiple languages that are used in different communications between the core person and other people around them (Lexander & Androutsopoulos, 2021). Besides, in their study, the creation of mediagrams is accompanied by conducting family interviews and the LP activity, since the mediagram graph itself has limitations in representing the participants' multilingual repertoires alone (Lexander & Androutsopoulos, 2021). Mediagrams, as a way of visual presentation, also have unique features and are worth using in qualitative language and media studies. On the one hand, it can help the researcher capture the differences and similarities of the participants' mediational choices; on the other hand, it acts as a tool that encourages reflective communications during and following data collection periods (Lexander & Androutsopoulos, 2021). In my study, creating mediagrams of young bilinguals' touchscreen use is helpful for facilitating the following interviews and to generally understand children's touchscreen use and language choices. Therefore, I decided to adapt the mediagram design in my data collection and analysis processes.

Similar to Lexander and Androutsopoulos's study (2021), in my study, I first collected raw materials from the first family interviews and the LP activity with each family. Then I created an initial mediagram for each bilingual child to illustrate their touchscreen-using styles and language choices. However, while the original mediagram puts stress on the media and language choices for interpersonal interactions but not on specific communication purposes (Lexander & Androutsopoulos, 2021), I did not put the relevant people who communicate with the child in their daily lives around the core informant. Instead, I put the varied activities that the child does when using touchscreens at home around the centre, while putting the child in the middle of the touchscreen use mediagram.

Expanding on Lexander and Androutsopoulos's (2021) work, I changed the design of the original mediagrams to better suit my study aims and scope. The main reason for this change and design is that the stress of my study is the connections between a child's language choices and their touchscreen activities and use of apps. My focus is different from the main aim of Lexander and Androutsopoulos's (2021) study, which is

to explore the multilingual mediational repertoires and the communications with extended interlocutors of every member of a family unit. Besides, in Lexander and Androutsopoulos's (2021) study, the languages they explored are multiple (more than three in each family). Whereas in my study, the languages that I explore are two (Chinese and English) for five cases and three (Chinese, English, and Bahasa Indonesia) for one case. Although interpersonal communication was also important in my study, this happened mostly between the child and their family members, and the language use during these interactions did not change much in most of the cases during my data collection. With all these considerations, I changed the original design of relevant partners around the core informant into specific touchscreen activities to better visualise the bilingual child's touchscreen use and language choices and offer a starting point for the reflective discussions in the following interviews.

Then, I apply different line styles and colours to connect the core child with different touchscreen use activities, which represent the languages a child uses in different activities. Meanwhile, I tried to add as many details as possible to the mediagrams by using the raw data collected from the family interview, the LP activity, and the parent-recorded videos. See the mediagrams in the individual case study analysis in Chapter 4.

Steps of developing the mediagrams in my study

In each case, the three mediagrams were created in an evolving way. The first mediagram was drawn after having the first family interview. After I drew the first mediagram of the child's touchscreen use map, I showed the mediagram to the family during the second interview with them. During the second family interview, after discussing and reflecting on the parent-recorded video clips, I encouraged the participants to add more details to the mediagram or amend it. They could choose to draw and upgrade the mediagram themselves or to let me draw it based on their oral reflections and ideas about the child's touchscreen and language uses. As stated in Lexander and Androutsopoulos's study (2021), creating a mediagram is not a static task; it keeps developing and needs the continuous collaboration of the participants and the researcher from the beginning to the final interview. In my study, the mediagrams were demonstrated and edited every time in all the following interviews with each family. Similarly, the third mediagram was amended after having the third interview and discussing the second mediagram and the second set of parent-recorded videos with the family. In these mediagrams, the child's bilingual/multilingual language choices in their various touchscreen activities were vividly demonstrated. Each mediagram will be analysed individually in Chapter 4, along with other data from the parent-recorded videos and the family interviews.

3.5 Data transcription

3.5.1 Selective transcription of family interviews

For the video-recorded family interview data, selective transcription was implemented when transcribing the data.

The necessity of selective transcription

First of all, the transcription of research data is selective and partial in nature (Davidson, 2009; Rapley, 2007). Even for a recorded conversation that only lasts for a few minutes, a great deal of detailed information is contained, and it is beyond a researcher's capability to transcribe all the information in the scene into a written transcript (Rapley, 2007). Besides, as transcription indicates the switch or translation of audio/video recording data to written transcripts, the researchers need to decide and select from the data and then interpret them (Davidson, 2009). Therefore, the selective feature of

transcription should not be understood as a drawback. Rather, the selection of data transcription is necessary and should be clarified and acknowledged when talking about the research design (Davidson, 2009).

Moreover, although verbatim transcription of audio and video data is commonly implemented in qualitative studies (Halcomb & Davidson, 2006; Rapley, 2007), the necessity of applying verbatim transcription to all the interview data in qualitative research is questioned (Halcomb & Davidson, 2006). The word-by-word transcription of data requires a significant amount of time and resources; therefore, the possible benefits of applying a verbatim transcription and the necessity of this time-consuming data transcription method should be weighed and considered (Halcomb & Davidson, 2006). In Loubere's (2017) fieldwork conducted in rural China, he planned to use a verbatim way to transcribe all the interview data, but he soon found it tricky since the recording process did not go smoothly as ideally planned. For instance, the recording environment was not ideal, some participants did not want to be recorded, and the individual interview became a group one if the family, neighbours, or friends of the participant became interested and joined the study (Loubere, 2017).

Therefore, from a practical angle, it is sometimes impossible to transcribe a conversation from a video/audio recording word-for-word. Similar to Loubere's (2017) study, in some of my video-recorded family interview data, the background noises meant that it was not possible for the researcher to grasp every word that the participants said. Also, the unstable Internet connections during the online interviews caused some pauses and delays, which made it difficult to transcribe the body language of the participants, especially the children. Meanwhile, unavoidably, the child and the parents sometimes spoke at the same time. All these practical factors in the real fieldwork made it tricky to apply verbatim transcription to family interviews in my study. However, it should be stressed that acknowledging the use of selective transcription does not mean that I deliberately select or ignore data on my own will while transcribing. Therefore, instead of transcribing all the data from the family interviews word for word, I transcribed all the data that I could hear and observe clearly into transcripts.

Naturalised and denaturalised interview transcription

Interview transcription in qualitative studies is a fundamental step of representing the collected interview data (Davidson, 2009; Nascimento & Steinbruch, 2019; Oliver et al., 2005). A simplified transcript is basically a descriptive summary of the recorded scenario (Rapley, 2007). However, the specific procedures of how to transcribe the interview raw materials to the data analysis stage are usually ignored when talking about methodology design (Nascimento & Steinbruch, 2019). Being aware of this methodological gap, I carefully proposed the detailed ways of transcribing interview data of my study. When transcribing the family interview recordings, I first reviewed literature on the general types of interview transcriptions and then formed my own way of transcribing the data.

There are multiple ways of transcribing qualitative data; naturalism and/or denaturalism are normally applied in transcriptive practices (Nascimento & Steinbruch, 2019; Oliver et al., 2005). From the perspective of understanding transcription as a social and cultural practice (Pelzang & Hutchinson, 2018), the definitions of naturalised and denaturalised transcriptions proposed by Oliver et al. (2005) are adopted here. Naturalised transcription is used to capture as many details in a sentence as possible, while denaturalised transcription focuses on standardising (Oliver et al., 2005). In naturalised transcription, the expressions in the interview are all transcribed accurately without being refined by the transcribers (Oliver et al., 2005). In the denaturalised transcription process, the transcribers aim at creating neat data for the following

analysis; therefore, the grammar is corrected, non-majority accents and speeches are removed, and external noises are removed (Oliver et al., 2005). Nonetheless, there is not a better way of transcribing qualitative data between the two, since each of them has its own benefits and drawbacks (Nascimento & Steinbruch, 2019). The naturalised transcription maintains most of the original expressions in the data, but the remaining pauses, slang, or noises can make it tricky for the readers to understand (Oliver et al., 2005). Similar, while denaturalised transcription offers a clearer transcript for the readers to analyse, the transcript may vary if it is refined by different transcribers (Oliver et al., 2005). In my study, as I am aware of the amount of interview data and that the focus of transcribing these data is to gain knowledge related to the research topics through mostly interview conversations with the participants, the denaturalised way of transcription is applied when transcribing the family interviews.

Procedures of transcribing the family interviews
Based on the selective nature of transcription in qualitative research (Davidson, 2009; Rapley, 2007) and the two main techniques of transcribing interview data (naturalised and denaturalised), I transcribed my family interview recordings in the following way:

First, when I finished a family interview with the participants, I saved the recording and transcribed the recording manually. By applying selective transcription, I did not include irrelevant information in the transcription, for example, how a parent orally replied to a message to her friend's text during the interview. Also, I did not transcribe some non-major speeches that were not relevant to the interview from the transcript. For instance, when the parents are talking to each other about their weekend plans with friends. Meanwhile, when doing the transcription work, I paid attention to maintaining the characteristics of each person's speaking style if possible. For example, I kept authentic sentences spoken by the participants in the interview, as long as the sentences were understandable and relevant to the research topic.

Besides, it can be challenging to transcribe multilingual interview data. While researchers and participants may use their multilingual repertoires to create translanguaging conversations during the interview, researchers should acknowledge the multilingual methodological dynamics and demonstrate their decision-making process when dealing with these multilingual data (Polo-Pérez & Holmes, 2023). In my study, since Chinese and English were always used together in the interviews, I kept the original languages that the participants spoke and did not translate them all into one language (i.e., English) in the transcript. In addition, to make the transcript as accurate as possible, I watched each interview recording at least three times and some interviews five times to keep refining the transcript as accurate as possible for further data analysis.

For the translation of bilingual qualitative data, some scholars suggest researchers should translate data themselves if possible, and the translation should be tightly related to the actual meanings of participants' utterances (Khilji & Jogezai, 2024). When demonstrating data in the findings and discussions, I kept the original transcript and translated the parts of transcripts in Chinese to English to improve the readability. As I did not have knowledge for Bahasa Indonesia, I asked for the parent's help to translate Bahasa Indonesia into English in an authentic way. All the translations were member-checked by the participants (Khilji & Jogezai, 2024) in my study.

3.5.2 Transcription of parent-recorded videos

Compared to family interview data, I found that the parent-recorded videos in my study often contained fewer oral communications. Instead, the video contents were more about the child's use of certain touchscreen apps and fragmental oral interactions. Also,

there were more body languages and fewer background noises in those videos compared to the interview data. Therefore, I used naturalised transcription as the main way to interpret the data, which meant to keep as much original detail of the video clips as possible. I did not transcribe much of the pauses in the transcripts, but I described the body gestures of a child and how the child operated the touchscreen apps during the videos in the transcripts. Examples of the transcripts can be seen in each case study analysis in Chapter 4.

Moreover, all the transcripts were transcribed with the original languages used in parent-recorded videos as in the interviews. Like the interview transcripts, when illustrating the extracts of transcripts as examples in Chapter 4, I also translated the Chinese parts of the transcripts into English following the original transcription for a better reading experience for the readers. The translations are double-checked by the participants as well.

3.6 Data analysis methods

The ways of data transcription and the data analysis methods have interrelations (Nascimento & Steinbruch, 2019). Considering the different characteristics of the varied data collected and transcribed in my study, different data analysis methods were applied to different types of data.

3.6.1 Thematic analysis of family interviews

Thematic analysis is a widely used approach in qualitative data analysis, it is applied to identify, analyse, and find specific patterns or themes through data (Braun & Clarke, 2006). When compared with other analytical methods, such as discourse analysis or narrative analysis, thematic analysis maintains more flexibility, because it is not limited to any precise theories or philosophical approaches (Braun & Clarke, 2006). Some scholars argue that although the analytical processes outlined in some published articles are thematic in nature, the data analysis method is not defined as thematic analysis; it is rather called content analysis or even not described as a specific method (Vaismoradi et al., 2013). From my point of view, it is necessary to understand and identify thematic analysis when applying it in a study data analysis procedure. In addition, during the thematic analysis process, both inductive and deductive codes can be generated and managed for further data interpretation (Gray, 2018; Kucirkova & Flewitt, 2022). By understanding the nature of flexibility, I chose to apply thematic analysis for analysing the semi-structured family interview data in my study in the following ways.

Thematic analysis is a process including multiple readings and accessing of the qualitative data, aiming to identify specific patterns, categorise main themes, and then interpret these themes with examples from the data (Kucirkova & Flewitt, 2022). It is vital to clarify each step of thematic analysis; therefore, researchers can use it more proficiently and accurately, resulting in more rich data analysis for the study findings.

Learning from the step-to-step guide (Braun & Clarke, 2006), I first immersed myself into the recordings of family interviews and transcribed them into written transcripts. Then, I built some initial codes when transcribing and familiarising myself with the data. These codes were both inductive and deductive, and while most of them emerged from the data, I also bore in mind the theoretical framework and research questions when designing the full set of codes. I chose different colours for each code and highlighted the relevant information for each code in the transcripts accordingly. The initial codes in each case study could be slightly different since the interviews in each case were individual and unique. All the codes generated in the interviews across all the cases

are listed as below:

- Children's language choices (use/development of Chinese, use/development of English, use/development of Bahasa Indonesia);
- Parents' role in children's home touchscreen adoption (parental attitudes, parental supervision, and parental mediation);
- Parents' role in family language choices (parental attitudes, parental supervision, parental mediation);
- Patterns of using tablets/apps (length, frequency, types of activities, features of tablet apps);
- Parent-child interactions;
- Child's agency;
- Other family activities and language development.

After generating the initial codes, I then tried to code some of the interview transcripts. During this process, I amended the initial codes and removed some repetitive codes with caution. The amended codes are:

- Children's language choices (use/development of Chinese, use/development of English, use/development of Bahasa Indonesia);
- Parents' role in home touchscreen adoption (parental attitudes, parent-child interactions, and parental mediation);
- Parents' role in family language choices (parental attitudes, parent-child interactions, parental mediation);
- Parents' role in family language choices (parental attitudes, parental mediation);
- Patterns of touchscreen use (length and frequency, types of activities, features of tablet apps);
- Parent-child interactions;
- Child's agency;
- Non-digital family activities and language development.

I then applied all the categorised codes to all the interview transcripts, analysed the coded data with caution, and identified themes from these coded data. Next, I wrote up the data analysis section according to the various themes that I identified from the coded data, also with references to related literature and theories. Several themes were extracted from the interviews, such as the close relationship between children's language choices and their family language policies, various touchscreen activities that influence children's digital literacy practices, and parents' vital role in children's home touchscreen use and language choices, which were discussed in chapters 4 and 5.

3.6.2 Observational content analysis of parent-recorded video

Content analysis is a useful data analysis method that offers new insights and deepens researchers' understanding of specific phenomena within a particular social context (Krippendorff, 2019). Content analysis can be generally described as a group of methods aiming at making systematic and reliable conclusions from texts and various forms of communication (Drisko & Maschi, 2015). The texts of content analysis involve not only the written materials but also many other types of communication that can be saved in different forms (Krippendorff, 2019), such as recordings, movies, images, and phone calls (Drisko & Maschi, 2015). The parent-recorded videos in my study belong to a form of text mentioned in the definition of content analysis. Considering the following features of content analysis, I chose this method to analyse these parent-recorded videos in my study.

First, content analysis is empirical in nature, with emphasis on understanding data within specific contexts (Krippendorff, 2019). When applying content analysis to these parent-recorded video data, I can systematically observe the patterns of children's

touchscreen activities, such as their specific actions, language use, and interactions, considering the influence of each specific home environment.

Second, content analysis can be used as a method that is less disruptive and maintains the natural setting of the interactions being studied, as it can process data after the data have been created (Krippendorff, 2019). Since the videos were recorded by parents in their natural home settings in advance, the content analysis of these pre-recorded videos did not influence the children's behaviours during the actual recording process. However, the influence of parents' recording on their children's behaviour should also be acknowledged; therefore, these video data in my study were always analysed together with the other data.

Third, content analysis offers systematic methods to deal with a large amount of data through the process of coding and analysis of coded data (Krippendorff, 2019; Drisko & Maschi, 2015). In my study, I collected several parent-recorded videos from each family; although these videos varied in length and amount in each family (as the parents decided on the contents of recordings), the total amount of videos I needed to transcribe and analyse was not small. Applying content analysis to these videos was a practical way to help me manage to capture the themes and details of these children's touchscreen use and interactions.

Apart from content analysis, I also considered the feasibility of using multimodal data analysis. During multimodality research that explores early childhood children's emergent literacy (Flewitt, 2011; Rowe, 2019; Wohlwend, 2015), data collection through visual technologies, such as the recorded videos, is frequently used. By considering the multimodal (Kress, 2010) nature of video data, researchers could closely examine children's literacy practices through different modes and semiotic analysis (Rowe, 2019), such as gestures, images, and sound effects (Wohlwend, 2015). While acknowledging the potential benefits of using multimodal analytical methods for video data, I chose to apply content analysis to analyse these videos for a practical reason.

For example, in a study examining the affordances of interactive touchscreen devices in two classrooms with children aged eight to nine (Davidsen & Vanderlinde, 2014), cameras were placed above the children, and a 22-second video clip of two children's engagements with touchscreen was presented with multimodal transcripts. The 22-second video data was transcribed and presented in the form of 68 still photos (3 photos per second) with speech bubbles and movement descriptions (Davidsen & Vanderlinde, 2014). This kind of multimodal data analysis has its special benefits of offering a child-led perspective to understand children's interaction with touchscreens and each other; however, as the example shows, this multimodal video analysis method can be extremely time-consuming (Davidsen & Vanderlinde, 2014). In my study, the typical length of one parent-recorded video was longer than one minute, and some of these videos were much longer (e.g., one of the videos was about six minutes long). Therefore, it is not practical to apply multimodal video analysis to all these parent-recorded videos. I may consider reanalysing a small part of these videos through multimodal data analysis methods for further publications based on my study.

Observational qualitative content analysis

To be more specific, as my study design is qualitative in nature, qualitative content analysis (QCA) (Drisko & Maschi, 2015) was applied. QCA is a method for systematically describing and interpreting the meaning of qualitative data (Schreier, 2012). Like the content analysis discussed above, QCA can be used to analyse visual data (videos and images) (Drisko & Maschi, 2015). It follows specific guidelines and

does not rely on numbers or statistics (Mayring, 2000). The specific steps of QCA are: 1) Deciding on a research question; 2) Selecting the material; 3) Building a coding frame; 4) Dividing material into coding units; 5) Trying out the coding frame; 6) Evaluating and modifying the coding frame; 7) Main analysis; 8) Interpreting and presenting findings (Schreier, 2012).

From the above step-by-step guidance, it can be seen that the coding process is key to content analysis; different contents should be categorised to help researchers identify and understand the themes within the data (Drisko & Maschi, 2015; Schreier, 2012). For the initial coding process, I used both deductive and inductive ways of creating codes (Drisko & Maschi, 2015). On the one hand, I started building the coding frame based on the research questions:

- Language choices (use/development of Chinese/English/other heritage language);
- Patterns of using tablets/apps (length, frequency, types of activities; features of tablet apps);
- Digital literacy practices;
- Parents' role in children's home touchscreen activities;
- Parent-child interaction.

On the other hand, I also immersed myself in the videos when transcribing the data. As mentioned in the data transcription section, I managed to observe and keep as many details of the original videos as possible. As content analysis usually maintains a descriptive focus (Drisko & Maschi, 2015), not only the verbal communications but the child's movements of operating the touchscreens and their interactions with the environments were all transcribed in a descriptive way. For example, I noted down the details of a young bilingual child who scrolled the screen while chatting with his mother. I also transcribed the information of the touchscreen contents as much as possible.

One thing worth mentioning is that the observation during the video transcribing process fits into the approach of digital ethnography (Cocq & Liliequist, 2024) as well. This observation here worked similarly to a face-to-face observation during fieldwork. I initially designed to observe children's touchscreen use at home myself, but due to the pandemic, I had to carry out the data collection online and ask for parents to record these videos and observe later. Therefore, I believe that the content analysis of these videos should be viewed as observational data analysis.

After transcribing these data, I also applied the inductive coding method to generate more codes that emerged from the data. These codes are:

- Interactions between the child and touchscreen;
- Child's independent touchscreen activity;
- Child's operational skills of touchscreens;
- Child's agency during touchscreen use;
- Parental mediation on children's touchscreen use;
- Oral language exposure/practice;
- Written language exposure/practice.

Combining both inductive and deductive codes, I then applied these initial codes to some video transcripts as trial coding, assessed these codes, and made amendments to maintain coding consistency. The combined and amended codes were then categorised as below:

- Language choices (use/development of Chinese/English/other heritage language);
- Patterns of using tablets/apps (length, frequency, types of activities; features of tablet apps);

- Digital literacy practices (oral language exposure/practice, written language exposure/practice, operational skills of touchscreens);
- Parental mediation on children's home touchscreen activities;
- Interpersonal interactions (parent-child interaction, sibling's interaction)
- Interactions between the child and touchscreen;
- Child's agency during touchscreen use;
- Child's independent touchscreen activity.

After coding and categorising the video transcripts with the amended codes, I then analysed these coded data and identified some key themes. I also tried to find possible patterns and prepared some questions based on the video data. Then I asked several of the questions in the following interviews with each family group to double-check my findings and encourage more reflections from the participants. The identified themes from each case study are demonstrated in chapter 4 with other data, and the main themes are discussed in chapter 5 in a cross-case manner.

3.6.3 Display and analysis of the evolving mediagrams

For each family group, I created the initial mediagrams of children's touchscreen activities and languages they used during these activities based on the information gained from the first family interview. These were adjusted by the participants and me together during the following interviews. The changes in the touchscreen and language use for each family are vividly shown in the mediagrams. Importantly, by adapting mediagrams in my study, the second and following interviews with each family went more smoothly compared to the first one. The participants tended to have a clearer idea when talking about the children's recent activities using touchscreens. They also shared more details and talked more reflectively about how the children use touchscreen apps and how they use languages during the related activities. Displaying and discussing the three mediagrams in each case study in an evolving way and with other data facilitates data triangulation and improves data validity; it also helps the audience to understand the changing patterns of these children's language exposures and touchscreen activities more vividly. The mediagrams will be used as a main tool to analyse each child's language choices through their touchscreen activities in the section of individual case study analysis in Chapter 4.

3.7 Ethical considerations

In both the digital ethnography approach and the case study approach, considering ethical issues in early stages is emphasised, as it is an important way to demonstrate the researcher's reflexivity (Cocq & Liliequist, 2024; Priya, 2021). For instance, a researcher should view the ethnographic research as collaborative and acknowledge the influences of participants on shaping the actual study process (Pink et al., 2015). My study involved both the children and the parents, and all the data collection took place online. For research relating to the field of children's digital literacy practices, it is not enough to just follow prevalent ethics guidance (Flewitt, 2019). Researchers need to be reflective and cautious about the specific ethical rules they may apply during the whole study process (Flewitt, 2019). I made several ethical considerations throughout my study and gained ethical approval from the ethical committee at the University of Sheffield before conducting any research fieldwork. In the following sections, I talk about the details that I considered for my study in different categories.

3.7.1 Research with children

When conducting research with children, it should be borne in mind that the children need to be regarded as capable participants who are able to illustrate their world by

using words and behaviours (Rivero & Gutiérrez, 2019; Sairanen et al., 2020). At the same time, researchers should also be cautious because children are often vulnerable both psychologically and physically (Christensen, 2000) Their abilities to express or interpret their emotions could be limited by their age, and it may be hard for them to fully convey the messages if they feel uncomfortable during the study procedure (Duncan et al., 2009). Therefore, children's participation requires more careful thought when designing and conducting my study.

First, it is necessary to value children's rights and their opinions in all situations, and children's voices on ethical issues should be listened to just as the other adult participants (Flewitt, 2019). So, I gained both the children's and the parent's approval before conducting the actual fieldwork, and I viewed the processes of gaining the children's assent and parent's consent as fluid and changeable (details in section 3.7.2). During the study, I valued children's rights through specific actions. I always encouraged children to express more about their thoughts and feelings. I asked children questions sometimes and let them participate more in the conversation. I always tried my best to understand children's opinions and do not use the view of children being vulnerable as an excuse to reduce their power.

Second, considering the vulnerability of children, I am alert to the potential harms that may exist during the whole study design. As my research only includes online research methods, such as having family interviews, mediagrams, and parent-recorded videos, the risk of foreseeable physical harm to my participants is minimal. However, potential risks may exist as some personal data are gained in my study (i.e., participating families' ethnicities), which belong to the "Special Category" personal data. Besides, I am also aware of the risks to the anonymity and confidentiality of personal data posed by storage technologies and the ways of processing identifiable data. Therefore, I carefully planned to minimise these risks in several ways, and details are explained in section 3.7.3 on anonymity, confidentiality, and privacy. In addition, I was always cautious while doing activities with the children. For instance, when having conversations with a child, I observed and checked their feelings and willingness to talk frequently.

Third, one tricky thing about researching with children at a young age is how to really communicate with them, especially for my study, which is all held online. To improve the interview interactions with the children, I used similar methods as Scott did in her study (2018), which also involved children and their families. In her study, instead of asking pre-prepared questions in the interview, she let the children lead the conversation while observing their physical behaviours and oral expressions (Scott, 2018). I tried to follow the children's paces during the interviews; for example, I encouraged children to explain and talk more about the topics that they wanted to discuss through both verbally and non-verbally methods (e.g., painting). Watching parent-recorded videos together in the interview with the family was one useful way to encourage the children to speak more about the research topic in most of my study cases. More about this will be discussed in additional finding section 5.7.

3.7.2 Informed consent and assent

Since the participants in my study are family groups, which includes both children and their parents, both parents' and the children's approvals should be gained before carrying out any fieldwork. Two essential principles should be kept in mind when gaining consent: one is to let the participants make decisions if they would like to participate in the study totally voluntarily; the other is to let them know what kinds of outcomes this study may achieve (Flewitt, 2019). I put the principles into the information letter that I wrote to the parents; I clearly stated the voluntariness of their

participation and informed them of the possible uses of the data and further outcomes of the study.

When gaining parent participants' consent, I sent them information letters and consent forms after initially communicating with them. I explained the research-related information in plain language for them to understand more easily. The languages I used to communicate and explain with the parents are altered according to their preferences. For most of the parents, they preferred me to explain in Chinese, and for one mother who did not understand Chinese, we communicated in English instead. I explained several details of the study to the participating parents, such as the backgrounds and aims of the study, how to protect their data, how they may engage in the study, the possible further use of data, the potential risks, and the benefits of participating. I gave the parents time to read through the information letter and explained the outline of the study process to them for further clarification. Also, I let them ask any questions they had and explained the possible concerns thoroughly. All the parent participants signed the consent form after I made sure they did not have further questions at that stage, and I also let them know that they could ask any questions during the whole study process at any point.

After gaining the parents' consent, I planned to gain the children's assent as well. If the study design lets the parents act as gatekeepers and represent the children to give consent, children's rights and agency of making decisions for their own lives are not fully considered (Dockett & Perry, 2011). Although it is argued that children's attention can be attracted when explaining the research information with multimedia visual and sound effects (Dockett et al., 2013), it is still a question for the researchers to know if the children can really give solid consent (Erstad et al., 2019). Children may be too young to offer informed consent, so their assent should be gained instead (Dockett & Perry, 2011).

To gain their assent, I first arranged short talks with the parents and children online before starting the first formal interview, to make the child more familiar with me. Then I asked for the child's assent every time before the interview after explaining to them what we would do during the interview. The child did not need to give any signed consent form; they could use oral expressions, physical hints, or drawings to express their feelings and opinions. I kept observing these hints when trying to gain the child's assent, and if the child turned out to be sad or grumpy, I would reschedule the interview or let the child leave the interview if they wanted. For the parent-recorded videos, I also asked the parents to gain their children's assent before filming any videos.

Moreover, it is worth mentioning that I treated the actions of gaining participants' consent and assent as an ongoing and changing process (Ericsson & Boyd, 2017). Therefore, I asked for the parents' consent and the children's assent every time before the interview and made sure they were aware that they had the right to withdraw, opt-in, and opt-out of the study at any stage without any reason. All the fieldwork was conducted after gaining their consent and assent. If they feel uncomfortable about using any of their information, they can always tell me, and their data would not be used in any further reports or publications if they do not want to.

3.7.3 Anonymity, confidentiality, and privacy

It is crucial to keep anonymity and confidentiality issues in mind when the participants share their personal life stories (Duncan et al., 2009). A researcher needs to make specific plans and take actions to protect the anonymity and confidentiality of the participants' data (Flewitt, 2019). In my study, all the data collected are regarded as confidential throughout the whole study procedure. The participants are all called by

their pseudonyms. Specifically for personal data, no identifying information is shown in the study, and only necessary personal data related to the research topic is collected. For example, the participants' ethnicity and age of the child were needed, while information about their family income or school name was less relevant and was not collected.

Besides, all data was stored on my password-protected and encrypted laptop. I protected the data safely during and after the study. The data were only shared with my supervisor when it was necessary; no other person accessed them. I also backed up the data securely on *Google Drive*, which was under university control and password protection. After transcribing the initial interview and parent-recorded video data, all names appearing in the transcripts and further writing were anonymised and pseudonymised. In addition, after gaining the participants consent, only the anonymised or pseudonymised data will be stored for post-research purposes, and all data will be destroyed three years after publication. The participants were informed of the whole process of how to process their data, and they could ask not to use their data at any stage.

More specifically, my study involves video data, for example, the recorded online family interviews and the parent-recorded videos. Therefore, it is vital to discuss the data anonymity and confidentiality of video recordings here (White, 2017). First, lots of personal information about the participants is displayed in the video-recoding data, and how to present the data while maintaining anonymity and confidentiality should be carefully considered (Anderson & Muñoz Proto, 2016). In my study, I gave the parents freedom to record videos of their children's touchscreen and language use at home and let them discuss with their children and decide if they wanted to film the face of their children. By letting the participants record their family touchscreen use according to their will, the risks of collecting data according to the researchers' intention can be alleviated (Flewitt, 2019). Moreover, as mentioned earlier, the primary data were only accessed by the researcher and the supervisor when necessary. I carefully transcribed the video data with as little personal information as possible and made sure that no recognisable data were presented. When illustrating some research findings with the video or image data, I used only pictures with the back or side profile of children to minimise the risks of leaking personal data. No identifying data was displayed in my thesis and paper.

In addition, the whole research is in line with the BERA guidelines in protecting the personal information of the participants, and storing and sharing data. All studies were carried out after gaining ethical approval and the participants' consent and assent. Every step in the study strictly followed the data protection guidance of the University of Sheffield, which can be found here: https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

3.7.4 Data integrity

Data integrity, or the quality of data, is essential to the success of a study; a lack of integrity could cause ambiguous and less-convincing results (Flewitt, 2019). When designing my study, I applied several methods to increase the trustworthiness and integrity of the data. First, since it is crucial to conduct a qualitative case study in a communicative and social way (Flewitt, 2019), I made efforts to get familiar with and understand the participants' daily lives by spending time chatting with them if they wanted to talk. I also considered my own positionality when designing the specific research procedures. As a Chinese-English bilingual myself, I used to use media to learn English (cartoons) at home when I was very young, which helped me and generated my interest in researching this area. And I wanted to explore how current

touchscreen technology could influence children's home literacy development. I tried to understand the participants' viewpoints from their perspectives and share my relevant experiences to enhance the depth of the conversations with the families. Meanwhile, I tried to respect and listen to both the parents and children's ideas during the interactions patiently. By doing these, the mutual understandings between the participants and me were fostered, and the participants were also encouraged to share more details and stories relating to their family language choices and touchscreen use experience.

Moreover, it is also useful to increase the integrity of the data by applying multiple data collection methods and forming data triangulation during the process (Little & Little, 2022). I used family interviews, mediagrams, and parent-recorded videos to collect data from different aspects and for member-checking. After finishing the first interview with each family, I painted the initial mediagrams according to the data from the first interview and then sent them to the families. Before the second interview, each family would send me the parent-recorded videos, and we would talk mainly about the videos they sent and how to improve the mediagrams during the second and following interviews. The data collection methods were closely associated, and the data were discussed with the participants to minimise the risks of researcher bias. With data triangulation like this, the trustworthiness of the data could be improved (Little & Little, 2022).

3.8 Researcher's reflexivity

From the above sections on my methodological design, my research aims and questions, the initial methodological orientations, ethical considerations, specific methods of conducting my fieldwork, and data interpretations are explained in detail. Before moving into the next chapter of the discussion on my research findings, I want to discuss more about the researcher's reflexivity in my study, as it is important throughout the whole study design and all the research processes mentioned in this chapter. I will reflect on how my positionality, potential biases, and experiences shaped my research process, especially how my researcher's reflexivity influenced the data collection and interpretation of my study.

3.8.1 Positionality and reflexivity

To begin with, I would like to briefly clarify why reflexivity is important in my research process and the concepts related to a researcher's reflexivity. It is widely believed that reflecting on a researcher's positionality when conducting qualitative studies is crucial (Bukamal, 2022; Soedirgo & Glas, 2020; Yip, 2024). My study is qualitative in nature and guided by the combination of digital ethnography and case study approaches; both approaches emphasise the importance of the researcher's reflexivity during the research process. Reflexivity is a key characteristic of a small-scale ethnographical study design; it demonstrates researchers' positionality that is associated with the research topic and contexts (Cocq & Liliequist, 2024). For example, researchers should reflect on how their presence during the research process affects the research participants or the environments. Similarly, a main challenge of conducting a case study is to consider how to maintain a relatively objective perspective and reduce the researcher's bias during the study (Yin, 2009). Researcher's reflexivity can greatly reduce this challenge by constantly reflecting on the researcher's positionality, perceptions, and bias (Priya, 2021). Therefore, the researcher's reflexivity plays a vital role during my research design and should be discussed in more detail.

Reflexivity refers to the process of reflecting on how a researcher's personal experiences and background can greatly influence the whole study process, from

design to data interpretation (Bukamal, 2022). A researcher's background and experiences are a researcher's positionality; it shapes their identity, which then in turn influences their ways of understanding the world and conducting research (Bukamal, 2022; Soedirgo & Glas, 2020). A researcher's positionality should be understood within specific sociocultural contexts; it greatly influences how a researcher chooses their research topic, designs their study, and interprets their findings (Rowe, 2014; Yip, 2024). Many factors, such as race, gender, values, and experiences, can affect a researcher's positionality (Bukamal, 2022); these factors may also shape the researcher's assumptions of the research topic, how they conduct fieldwork, and how they analyse the data (Yip, 2024). Therefore, to discuss reflexivity during my study process, I should clearly examine my positionality and explore how my positionality influences my study design and process. I will first reflect on my positionality in the following paragraphs and illustrate how my personal experiences and beliefs bring me to my PhD research.

3.8.2 My positionality and research interests

I am a Chinese girl who was born and raised in a northern city in China. Back in the earlier stages of my life, I was interested in technologies and languages from a young age. When I was little, my mother bought me some Disney video tapes in English that could be played on television. Growing from a Chinese monolingual environment, watching these English videos was the beginning point for my interest in learning and exploring language. These videos not only forged my initial interest in this language, but also actually facilitated my English development. I found that I had learnt some basic English words and expressions before the mandatory English classes in my primary school started. When I grew older, I first came to the UK as an exchange student during my bachelor course, and later I came to London to pursue my master's degree after completing my bachelor study. After graduating from my MA program, I then started my PhD journey in the UK. Considering the sparks of my interests in technology and language since a young age, I developed clearer research interests during my MA study. When I took care of my young cousin, who was only three years old, I noticed that he engaged with a touchscreen device independently and learnt some English expressions from some videos. I found it interesting as no family members at that time spoke any English to him, and the way he watched cartoons on his mini iPad reminded me of my own childhood experiences of watching those Disney cartoons and first getting to know the English language. Besides studying how touchscreens might influence a child's language experiences, the sociocultural contexts of Chinese migrant children in the UK contexts also added another layer to my research interests. Therefore, after researching literature into relevant fields, I designed my PhD study aiming to explore and understand the experiences of some children's family language choices and touchscreen use with a group of Chinese heritage families in the UK context.

3.8.3 Insider/outsider positionality and research design

In qualitative studies, researchers may find it difficult to define a researcher's positionality as a complete insider or outsider (Bukamal, 2022; Yip, 2024). For example, when doing research with some transnational migrant families and the researcher shares similar backgrounds with the participants, some participants may expect the researcher to communicate with them as an insider, and the researcher may need to demonstrate empathy and equip with specific sociocultural knowledge (Winarnita, 2019). Although the researcher actively engages and presents within the research contexts, it should be acknowledged that a researcher cannot be simply considered as another participant considering their outsider positionality (Winarnita, 2019). Some qualitative researchers have found that their positionalities fit into a middle space

between being an insider or an outsider (Bukamal, 2022; Yip, 2024). I also felt the same way when reflecting on my own positionality and my research design.

As mentioned in the above section, my personal experiences, observations, and interests in technology and language studies shaped the initial research interests and aims of my study. When designing my study methodology, I first viewed myself as an insider. Based on my research questions, the participants in my study should be Chinese heritage families with Chinese-English bilingual language environments at home and living in the UK. Being a Chinese who had been living and studying in the UK for a few years, I viewed myself as a bilingual and shared the same race with most of my participants. I might also share similar life experiences with my participants as well. I combined both digital ethnography and the case study approaches to guide my study design, trying to form close relationships and actively engage with my participants (Forberg & Schilt, 2023) and gain in-depth knowledge about their experiences in each family (Gray, 2018). However, when I clearly thought about my positionality, I then viewed myself as an outsider. I was born and raised in China, but the participating children were all born and raised in England, and their parents were first-generation immigrants to the UK. The nurturing environments of me and the participating children, the life experiences of me as an international student, and the participating parents as new immigrants were not the same. Therefore, when designing the specific research methods, I paid special attention to reflect on my assumptions and the researcher's bias (Yip, 2024).

After investigating the two methodological drives of my study, I began to structure my specific research questions. Guided by the case study approach, at the planning and design stage (Yin, 2009), I carefully examined my assumptions related to the research topic. As I mentioned above, my personal experience of using technology facilitated my language development, and I might be too optimistic about the benefits of engaging with technology. As researchers exploring digital technology in education, it is important to maintain an academic focus and identify possible influences of technology on children's development on both sides (Tshuma, 2021). In addition, one principle of the digital ethnographic approach is to view digital media as integral to the specific research context instead of separating and putting the digital element in the centre of the study design (Pink et al., 2015). At the beginning, I did assume that children's touchscreen use should be studied thoroughly, and all data collection should be tightly related to their touchscreen activities. But children's family life consists of multiple digital and non-digital activities; only focusing on collecting data of their digital literacy and language experiences during touchscreen use may not tell the whole story. I therefore designed my research questions to firstly collect information about the general patterns of these children's family language choices and then to better understand how they use touchscreens to practise languages within each specific family context.

3.8.4 Reflexivity and data collection

As stated in section 3.4, I applied multiple research methods to collect data. Three semi-structured family interviews (Little, 2024), including an ice-breaking language portrait activity (Soares et al., 2020), were conducted online with each family. Between the interviews, parents recorded videos (Wilkinson et al., 2020) of their children's home touchscreen activities and sent them to me. These videos were then discussed in the following interview with the evolving mediagrams (Lexander & Androutsopoulos, 2021) of children's touchscreen activities and language exposures that I amended each time after the previous interview. I constantly reflected on my positionality when designing and conducting the data collection.

First, for the interviews, a researcher's positionality and professionalism influence how they interact with the participants (Yip, 2024). As many of my participants and I spoke both Chinese and English, I let them choose the languages that they preferred to speak with me at the beginning and during each interview, instead of holding the interviews in languages based on my assumptions. Applying the language portrait activity also helped me to gain a better understanding of how these bilingual children understand languages, as they did not necessarily have the knowledge about the two languages as I estimated at the beginning of the study. For example, some children did not know the term for Chinese, or could not distinguish the two languages in this activity. I also considered the situations when my participants assumed that I already had certain knowledge or could show empathy for their experiences. In this case, I kept listening and making fieldnotes, then I often shared my understanding about the things that I noted down with them when they finished explaining a short topic.

In addition, another consideration of my positionality during the interviews is about how my presence may influence the participants' sharing of their thoughts (Forberg & Schilt, 2023). Like Yip's (2024) reflection on her positionality during interviews, participants sometimes are reluctant to share negative experiences or deeper thoughts when considering the backgrounds of the researcher at the first interviews. As one topic of my study during the interview was about the heritage language (HL) maintenance at home, some participants, especially the parents, often emphasised sharing their positive attitudes and strategies of maintaining HL. I understood this potential situation at the beginning of building up researcher-researched relationships (Yip, 2024). I designed three interviews with each family and implemented the co-viewing and drawing activities to boost children's interests. I also frequently checked the young participants' feelings during the interview. As the interviews were semi-structured, sometimes I asked prompting questions and encouraged the participants to share more details related to the research topics. I made these efforts to build up more positive and trusting relationships with all the participants with patience. Most of the participants, especially some children who were a bit shy in the first interview, tended to express more in the following interviews.

Then, for the parent-recorded videos, I processed the parent-recorded videos based on reflexivity in two steps. I first observed and transcribed the parent-recorded videos while making some notes, as one way to observe children's touchscreen use in their natural home environment. It minimised the risks of the researcher's presence in influencing the participants' natural behaviours (Paay et al., 2022). Then, as observations are often affected to some degree by the researcher's positionality (Priya, 2021), I also watched and discussed these videos with each family in the following interviews for member-checking and reducing the researcher's bias.

For the mediagrams, as I initially created and amended these mediagrams, I was aware of the risks of subjective interpretations. I always demonstrated and discussed these mediagrams with the participants, listening to their suggestions and amending the mediagrams together.

3.8.5 Reflexivity and data interpretation

One common concern of qualitative researchers is that they do not want to interpret data in a way of showing their own voices; rather, they want to demonstrate the voices of the participants (Maake, 2021; Snyder & Turesky, 2023). Based on this concern, a researcher's reflexivity is needed and necessary. A researcher should be aware of how their positionality may influence the ways of interpreting data. However, some scholars warned that being too obsessed with reflections when interpreting data may slow or even stop the research process, making it hard to produce reliable findings (Giddens

& Sutton, 2021; Priya, 2021). In my study, I reflected on my positionality during the data interpretation through several methods. While trying to maintain an objective tone when engaging and interpreting the data as much as possible, I also admit researcher's biases and positionality could influence data interpretation to some extent (Priya, 2021; Tshuma, 2021).

I transcribed all the interviews and parent-recorded videos manually and created the evolving mediagrams based on these collected data. I was aware of the vital role of my positionality in the data transcribing and interpreting processes; one aspect was my knowledge about languages. As many of the interviews and parent-recorded videos include the use of both Chinese and English, I tried to transcribe and maintain the original language used in conversations to better maintain the participants' voices. Then, considering the audiences who read my research findings, I also attached an English translation next to the original Chinese expressions when presenting some data. I was aware that the translation of the original texts was largely related to my bilingual language skills, so for member-checking and increasing the validity of data interpretation, I asked the parents in each family to read my translations and check if these translations convey the original meanings accurately.

As mentioned in section 3.6, although I referenced literature and applied step-by-step data analytical methods to code and analyse the three kinds of data accordingly, my positionality still influenced the whole process. I analysed the three kinds of data together instead of separately to form data triangulation (Little & Little, 2022), and I reflect on my potential researcher's biases and assumptions as another way to improve data validity and credibility (Priya, 2021). Like the data collection process, during data analysis, I also frequently made notes when coding and trying to interpret some data. I checked related notes in different sorts of data and improved the validity. Some of my assumptions could align with the participants' ideas, but some might only tell part of a story.

In the following chapter, data interpretations and discussion in each case study were thoroughly presented.

Chapter 4 Discussion and findings in Individual Case Studies

In this chapter, the data collected from each family will be analysed separately. For each case, the basic information about the family and child and the data collection process are introduced. Then, the language choice of each child is analysed with the demonstration of their language portrait (LP) (Busch, 2018) pictures and the discussion of their Family Language Policy (FLP) (Wilson, 2020) in each family. The third part of each individual case analysis is the illustration of the child's three evolving mediagrams that adapted from Lexander and Androutsopoulos's study (2021) and discussion of the child's multiple language uses during their family touchscreen activities, with a focus on parental role. The mediagrams in each case study are created and amended by following the same method. Each child's name is put in the middle of the mediagram, and their touchscreen activities are listed around the centre. The names of apps that the child uses during a touchscreen activity are listed around this activity. Different lines that represent various language exposures during these activities are drawn to connect the child and their touchscreen activities. In all the mediagrams in my study, purple is used to represent Chinese while yellow is used to represent English. The oral language exposures, including listening and speaking during the touchscreen activities, are illustrated as dotted lines in the mediagrams, and the written language exposures, including reading and writing in the touchscreen use, are illustrated as straight lines. For the trilingual child Feifei, green dotted and straight lines are used to represent Bahasa Indonesia in her mediagrams. Similarly, for Mango, who regards himself as trilingual, blue is used to represent French in his mediagrams. In addition, Bronfenbrenner's bioecological model is applied with other literature when discussing some specific touchscreen activities and language practices of these bilingual/multilingual children. As each case study analysis contains detailed information and is long in length, I only related to the bioecological model concisely in each case and did not involve thorough discussions of this model in each case's summary. Rather, I tried to give a more detailed explanation of how to implement Bronfenbrenner's model in the cross-case analysis.

4.1 Feifei's case study

4.1.1 Introducing Feifei's case

Feifei was a three-year-old girl who lived in southern England with her parents when she participated in the study. Her father was Chinese, and her mother was from Indonesia; she was born in England. She was a trilingual child who could speak Chinese, English, and Bahasa Indonesia (also known as Bahasa).

The family was recruited through the snowball method (Noy, 2008), word of mouth. The father expressed his interest in participating in the research, and then the information letter and consent form were sent to the parents. The parents signed the consent form, and the oral assent of Feifei was obtained each time before and during the interviews. Three family interviews were conducted with this family online via *Google Meet*. By the time of the first interview, Feifei had just come back from visiting her grandparents in Indonesia and started going to nursery school in England.

The total length of the three family interviews that were conducted with Feifei's family was about 4.5 hours. Due to the time flexibility of the family, the first interview was conducted with Feifei and her mother; the second interview was held with Feifei and both her parents; and the third interview included Feifei and her father. The second interview was conducted one month after the first interview, and the third interview was held one and a half months after the second interview. During the intervals of the three interviews, two sets of parent-recorded videos were sent to me (4 video clips, 18 minutes in total). Three evolving mediagrams were drawn and edited after holding each

interview with the family.

4.1.2 Feifei's language choice

In Feifei's case, all three languages, Chinese, English and Bahasa Indonesia, were interwoven into her daily communication. The details of her language choices will be analysed below with an illustration of the language portrait activity and other data from the interviews and parent-recorded videos.

4.1.2.1 Language portrait (LP)

At the beginning of the first interview, with a printed body silhouette of a little girl, Feifei successfully chose three colours for the three languages she could speak in the LP activity: dark blue for Mandarin, light blue for Bahasa Indonesia, and red for English. As demonstrated in the painting below, when Feifei was drawing this picture, she painted mainly from the head to the body with all the three colours, and the head was painted several times with all the three colours. She used light blue the most, followed by red and dark blue. According to Tatham-Fashanu's (2021) study, involving children in exercise-based LP activities generates greater interests and reduces stress compared to traditional interview methods. Although it was challenging for Feifei to explain her painting orally at a young age, there was still a chance to understand her language choices from the LP activity.

During the LP activity, the following conversation took place when talking about the choices of colours:

M (Feifei's mother): Why, why that Mandarin is dark blue? Do you like blue?
F (Feifei): Because I like blue.
M: Because you like blue.
R (Researcher): Oh, you like blue. Ok, cool!
M: It's her favourite colour for now. It's blue.
…
M: Do you like red?
F: I like blue.
M: You like blue.
R: Cool, then why you choose red for English?
M: The red is for the English one? Yeah?
F: Yeah.
M: Why you choose it for the English one?
(Feifei thought for a while and did not answer that.)
(Quote 4.1.1)

From the conversation, Feifei was affirmative that she liked blue, and her mother said that blue was her favourite colour. She chose her favourite colour to represent Mandarin (dark blue) and Bahasa Indonesia (light blue), but chose red for English. The connection between Feifei's colour preference and the languages may suggest her different emotions towards the different languages. Similarly, although Feifei expressed that she liked all three languages, when her mother asked about her favourite language before the LP activity, she said, *"Oh, Bahasa Indonesia. (Quote 4.1.2)"* It matched with the way she painted in the LP (i.e., Feifei painted in light blue most).

In a study investigating multilingual children's emotions and language use preference in Belgium, children's (aged 10-12) emotional preferences for languages were closely related to their proficiency in the heritage language, their parents' or siblings' language use, and their attitudes towards the importance of their heritage and institutional

languages (Dekeyser & Agirdag, 2021). However, in Feifei's case, although the girl communicated more fluently and frequently in English and Chinese with her parents in daily family life, her favourite language was Bahasa, which she just began learning to speak after visiting her grandma in Indonesia for five weeks. Feifei was more willing to express herself in Bahasa, as she regarded this HL as conveying more emotion when video calling her grandmother (Zhao & Flewitt, 2020). From my observation, Bahasa was related to Feifei's strong emotions, and she was passionate about knowing more about this language. For example, as her mother said in the first interview, during the video calls with Feifei's grandmother, her grandmother would react happier if Feifei replied in Bahasa. Her mother said that "*She (Feifei) is more excited if she can express in Bahasa; she is proud of herself if she can explain. (Quote 4.1.3)*" Therefore, her grandmother's encouragement made Feifei experience excitement and pride when speaking Bahasa. These kinds of positive emotions motivate Feifei to acquire and practise more Bahasa voluntarily.

Apart from that, Feifei also related Bahasa to another strong emotion. As her mother said in the second interview, *"Yeah, sometimes, sometimes if I am angry and I would (speak) in Bahasa Indonesia, so she (Feifei) said she's just upset, and she said, 'don't speak Bahasa Indonesia!' (Quote 4.1.4)"*

Her mother explained that it was easier for her to express her bad feelings in her heritage language, but if she was angry and spoke in Bahasa, Feifei would connect her mother's anger with that language. Feifei felt frustrated and wanted her mother to stop speaking Bahasa; this showed an intention to let her mother stop being angry. Therefore, not only the mother linked the emotions with the HL, but also the child. Above all, I think that the child connected her language preference with her strong emotions and recent experiences closely. The engagement with Bahasa might help the girl link and recall some recent events and emotions.

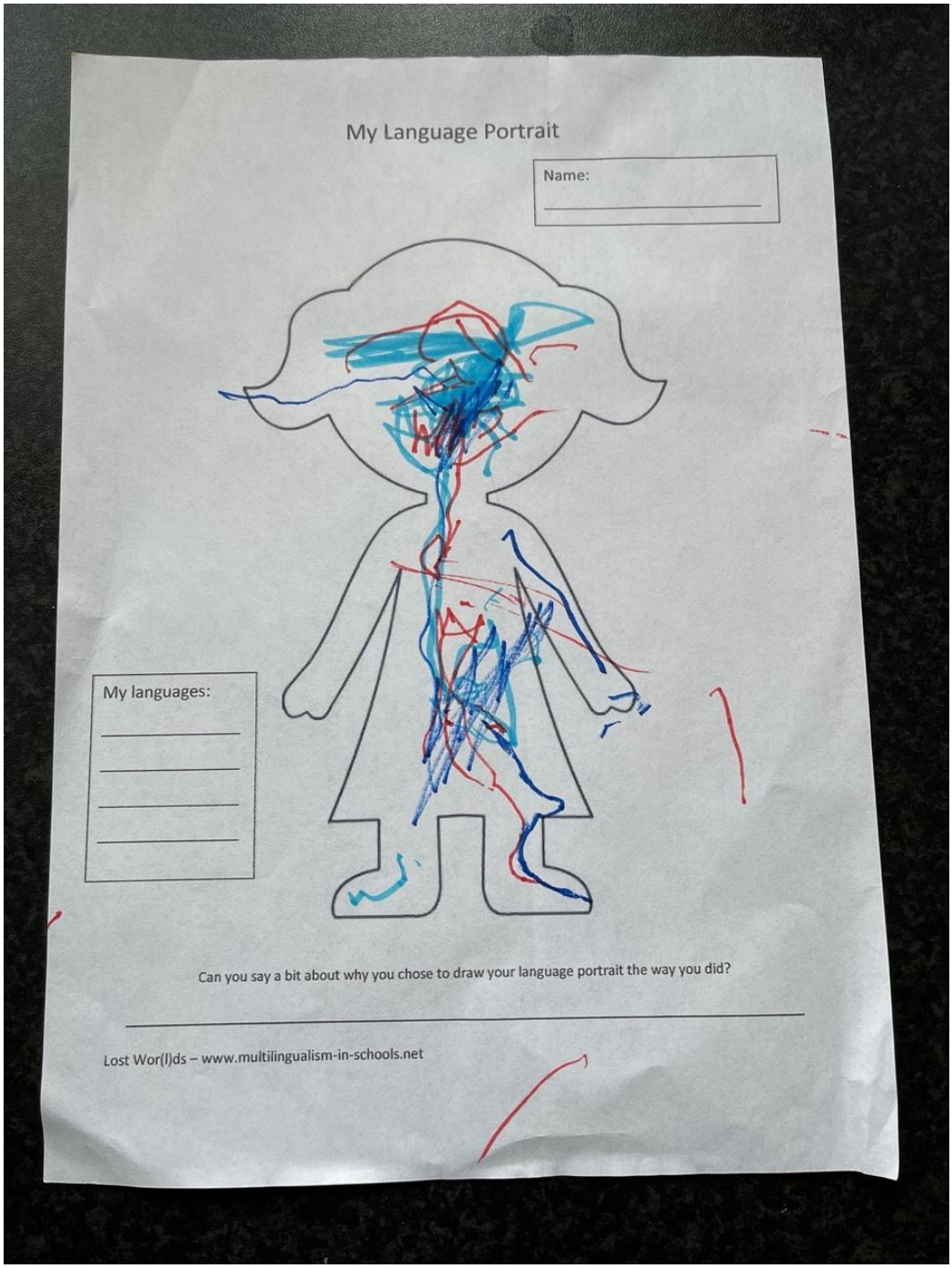

Image 1 Feifei's language portrait

4.1.2.2 Family language policy (FLP)

During the data collection period, the family language policy (FLP) (Wilson, 2020) in Feifei's family was rather stable and had some unique features. The FLP also varied between the father and the mother when they communicated with Feifei.

First, the father and the mother had different oral language management methods during their daily communication with Feifei. According to the parents, they communicated with each other in English for most of the time because they could not speak each other's heritage language (i.e., Bahasa Indonesia and Chinese). However, when talking to Feifei, the father said he tried to only speak Chinese with the girl for

most of the time, "*我偶尔会说英文，但是呢 90%以上都会跟她说中文 [I speak English occasionally, but more than 90% (I) speak Chinese with her] (Quote 4.1.5)。*" The father would only speak English to Feifei when she asked her father how to pronounce words in English. Otherwise, he intended to speak as much Chinese as possible to Feifei. For example, as the father illustrated in the second interview, he used the Chinese vocabulary '*平板电脑*' instead of '*iPad'* when talking to Feifei and referring to the iPad that Feifei used at home.

The father expressed the reasons for his language choice in the second interview: "*中文的话，除了我跟她说，她就没有别的渠道了 [As for (speaking) Chinese, only I speak it with her, she does not have any other channels (for practising Chinese)] (Quote 4.1.6)。*"

The father was also worried about the limited Chinese-learning resources in England. The emotional bonds to the heritage language of the first-generation speaker could influence their language attitudes and choices for the second generation (Ivanova, 2019). He felt it was necessary to speak as much Chinese as possible to help Feifei learn and maintain this language. He said in the second interview that "*如果我不教的话，可能过几年她也会忘 [If I did not teach (her), maybe she would forget (how to speak Chinese) after a few year] (Quote 4.1.7)。*" HL is a tie to enhance family bonds and the recognition of one's culture and identity (Chen et al., 2021; Wang, 2023), and the father set it as a prior goal for the girl to maintain that language.

As for the mother, she used mostly English when communicating with the girl. But recently, Feifei wanted to use more Bahasa and decrease the use of English during mother-girl daily communication. There were reasons behind this changing language choice. The mother said in the first interview that they wanted Feifei to learn all three languages simultaneously when she was a baby, but when Feifei was 20 months old, she was only able to speak limited words, and the mother removed the exposure of Bahasa at that stage. So they decreased the use of three languages into two; as she explained in the first interview, *"We just spoke two at that time, Mandarin because my husband still sticks to Mandarin. But I didn't speak Bahasa. (Quote 4.1.8)*"

However, by the time of our first interview, the mother and Feifei had just come back from their five-week vacation visiting families in Indonesia. She found that Feifei could speak whole sentences in Bahasa. Therefore, the mother believed that it was a good timing to reintroduce Bahasa. As she said in the first interview, "*…because she started to go to school this June, last month. So, I try to decrease the amount of English I speak to her, into Bahasa*. *(Quote 4.1.9)*"

Different from the father's insistence of only speaking Chinese with the girl, the mother had some different strategies to teach Bahasa:

> *"Most of the time, I just translate. It's, it's in there in English, so what's, for example, 'drink water' in Bahasa? (It's) 'minum air', stuff like that. What I am doing is just translate what she was talking in English, translate it into Bahasa, so she just learns the word that way. (Quote 4.1.10)"*

For the mother, translation between English and Bahasa was helpful in helping the girl acquire more Bahasa vocabulary. Besides, compared to the frequency of using touchscreens with her father, the mother read books and sang songs more often with

Feifei. For Bahasa, the acquisition of oral language was still a focus. As she mentioned in the online message that she sent me after the third interview:

> "*She's (Feifei) into reading books now before bed. I read books in Bahasa Indonesia or English (depending on the books she chose). (Quote 4.1.11)*"

Apart from their HLs, both the parents expressed no concerns about Feifei's English development because they believed that Feifei had a sufficient English environment, just as the mother said in the first interview, "*Because I know she speaks English at school, and she is able to communicate at school already. (Quote 4.1.12)*". As some studies suggest that the beginning of school makes the parents prioritise the dominant language English (Curdt-Christiansen & Morgia, 2018) over their HL or better academic performance (Little, 2019), this FLP and language choice in Feifei's case were different from these findings. The parents, especially the mother, made more efforts to help Feifei develop her Bahasa after she entered the nursery. However, although the parents expressed that they were satisfied with Feifei's English capacity during the data collection period, it did not mean that their FLP would not change afterwards. When Feifei grows older and may face more academic needs in her further school journey, it is possible that the parents may alter their current FLP and stress on her English development later.

Moreover, Feifei was able to distinguish all the three languages around her, and she knew how to use the proper languages when talking to different people. This pattern of her language choice is clearly demonstrated in the following two conversations.

First, Feifei and her mother discussed her language use in the first interview as follows:

> *M: How many languages can you speak? What language do you speak with Baba (i.e., Feifei's father)?*
> *F: Mandarin.*
> *M: Umeh datuk [(With) grandma grandpa]? Bahasa Indonesia.*
> F: Iya. *[Yes.] Bahasa Indonesia.*
> *M: Bahasa Indonesia. And with mama?*
> *R (researcher): Bahasa Indonesia?*
> *F: English.*
> *M: English, well. Uh-huh. So, you can speak Mandarin, and…*
> *F: Bahasa Indonesia.*
> *M: And then?*
> *F: And then English.*
> *M: So how many languages are there?*
> *F: One, two, three.*
> *M: Three, well done.*
> *(Quote 4.1.13)*

In this conversation clip, Feifei spoke English with her mother most of the time, but she replied to her mother in Bahasa when her mother asked one question in Bahasa (as the wavy lines above show). Similarly, Feifei discussed her language use again with me and her father in the third interview:

> *R：那Feifei，你最近在家里跟妈妈说什么语言呀 [So Feifei, what language(s) do you speak with mom at home recently]？你记得吗 [Do you remember]？*
>
> *F (Feifei)：英文[English]。*
>
> *R：英文，好棒 [English, great]。那你去 nursery 跟小朋友们说什么语言呀 [And what language(s) do you speak when you go to nursery and talk to your friends]？*

F：也说英文 [Also speak English]。

R：哇好棒，也说英文 [Wow great, also speak English]。那你跟爸爸说什么语言呢 [And what language do you speak with dad] ？

F：嗯，中文 [Hmm, Chinese]。

R：中文 [Chinese]。那你跟 grandma 视频的时候说什么语言呢 [And what language(s) do you speak when facetiming grandma] ？

F：嗯，说印度尼西亚语 [Hmm, speak Bahasa Indonesia]。

D (Feifei's father)：跟奶奶呢 [And with grandma (the original Chinese word means her father's mother in Chinese)] ？

F：说中文 [Speak Chinese]。

D：跟奶奶说中文，是的 [Speak Chinese with grandma, yes]。

(Quote 4.1.14)

In this example, Feifei spoke Chinese with her father and me; she knew the terms of the three languages that she could speak in both English and Chinese. The two conversation examples indicated that Feifei could clearly distinguish the three languages and formed habits of speaking different languages with different family members and other people. As in the examples, she spoke in English most of the time and sometimes in Bahasa with her mother, and she spoke Chinese during the conversation with her father. Her language practices matched with the FLP strategies that the parents mentioned in the above paragraphs. Therefore, Feifei's language practices were also closely related to her parental language management (Curdt-Christiansen, 2009). As the most intimate family members, both parents showed positive attitudes to help the girl learn and maintain their HLs separately during their daily communication. Feifei's FLP showed a prevalent situation for HL speakers; as their HLs were non-dominant in society (Rothman, 2007), the speakers always picked up these languages during daily communications within family/community environments (Kupisch & Rothman, 2018).

Another language use habit or language choice of Feifei was that, instead of mixing different languages in a single sentence, Feifei was more used to speaking each language separately. This feature of her language choice was shown several times during the interviews and parent-recorded videos. Apart from the two conversation examples mentioned above, another example extracted from one of the parent-recorded videos is illustrated below:

(Feifei and her parents are playing a car game on an iPad together.)

F (Feifei points at the left column and asks): 还有哪个，爸爸 [And which one, dad]?

D: 往上走到哪里了 [Go up, where did you arrive]? (Her father points at a green spot on the screen and asks) 走到这里了是不是 [You arrived here, aren't you]?

M: Turn left, or right?

D: 走到这里了应该是往右边走 [You arrived here and then you should go right]。

……

M (Her mother touches Feifei's arm and asks): Feifei, what are you doing?

D: 先直走 [Go straight first]。

M (Her mother touches Feifei again and asks): Hey, what are you doing?

F (Feifei points at the car and says): 直走 [Go straight]。I'm playing this game, I'm

just, because this car like this.
(Quote 4.1.15)

In this conversation, Feifei asked for her father's help to move the car on the screen in Chinese, and she repeated the Chinese instruction '*直走 [Go straight]*' that her father said to her (as the underlines show). Then she quickly switched to speaking English to answer her mother's question (as the wave lines show). Instead of mixing English and Chinese together, she spoke only English to her mother and only Chinese to her father, as she used to do in daily communication.

In addition, the child's choice of language can be restricted by her different levels of language capacities. For example, as her mother said in the second interview, when Feifei made video calls with her Indonesian grandmother, she was keen to speak in Bahasa, and she only spoke English when she did not know the vocabulary in Bahasa:

> "*She knows the word 'rice' is 'nasi', and she will just say 'makan nasi', means 'eat rice'. But when she doesn't know the word, for example, 'chicken', she doesn't know 'chicken' in Bahasa. She just replies in English, 'Oh, I eat chicken'*. *(Quote 4.1.16)*"

In this example, although Feifei preferred to speak Bahasa to her grandmother, her limited Bahasa vocabulary made her switch to English, in which she was more fluent. Similarly, Feifei had different vocabulary in Chinese and English as well, and different levels of language expression may influence her communication choice. In a story her mother told me in the first interview, Feifei knew the names of two similar snacks in Chinese, which were called '*雪糕 [ice-lolly]*' and '*冰淇淋 [ice-cream]*'. But she did not know how to say '*雪糕 [ice-lolly]*' in English and only knew the word 'ice-cream' in English at that time. As she could distinguish that they were two different snacks, after eating an ice-lolly at nursery that day, Feifei only shared the experience with her father in Chinese but not with her mother in English due to the lack of English vocabulary for the key word. The mother only knew it because her father translated and explained it to her in English. Therefore, Feifei chose to communicate with different people or in different languages because of her varied trilingual language capacities.

Looking through the lens of the bioecological model (Bronfenbrenner & Morris, 2006), Feifei's trilingual development is primarily influenced by the family's parent-child interactions in their regular family activities and communications over time (i.e., proximal processes) in their family environment. These kinds of parent-child interactions are bidirectional (Navarro et al., 2022), parents and their children exchange knowledge during the proximal processes to develop languages. For example, her father insisted on speaking only Chinese to Feifei, and Feifei often responded in Chinese. Both parents mentioned their efforts to actively engage in Feifei's development of HLs in their home environment (MacLeod et al., 2024).

When looking into the PPCT model (Bronfenbrenner & Morris, 2006), Person characteristics of both Feifei and her parents, Context and Tme all influence how effectively the proximal processes work for her trilingual development. First, Feifei's parental language management strategies mentioned above demonstrated her parents' force (e.g., language attitudes and beliefs) and resource (e.g., language skills) characteristics in influencing Feifei's language choice and development. Second, as the developing child, Feifei also played an active role in her own language development (El Zaatari & Maalouf, 2022). For example, she chose to use different languages when talking to different people based on her will and knowledge (forces and motivations), which demonstrates her equipped language skills (resources). She

also demonstrated interests and motivations (forces) to develop all the three languages, especially Bahasa. Third, the change of contexts and time may influence the direction of proximal processes (Bronfenbrenner & Morris, 2006). For example, during her first visit to Indonesia, Feifei developed emotional connections and basic Bahasa oral skills through the proximal processes (e.g., interactions with grandmother) in Indonesia, which was not a usual immediate environment for her. When coming back, Feifei started to speak both Bahasa and English with her mother.

4.1.3 Evolving mediagrams

From the first mediagram to the third one, the visualisation of Feifei's touchscreen use was developed step by step to the final version (the third one) with the family. More about Feifei's trilingual language choices and digital literacy development will be discussed below with the evolving mediagrams and the associated data of interviews and parent-recorded videos.

4.1.3.1 Feifei's first mediagram

Children's use of touchscreens is complicated and involves multiple digital skills, information gathering, language development and social activities (Little, 2020). It can be seen from the mediagrams that Feifei's touchscreen activities and language choices at home were diverse. There were activities like playing game apps, learning Chinese via an app, taking pictures, checking photos and videos, making video calls with remote family members, and watching some videos. According to the interviews, the touchscreen devices that Feifei was able to access were an iPad and her parents' mobile phones. Apart from using phones to take pictures, checking the album, and making video calls, she did all the other touchscreen activities using the iPad at home.

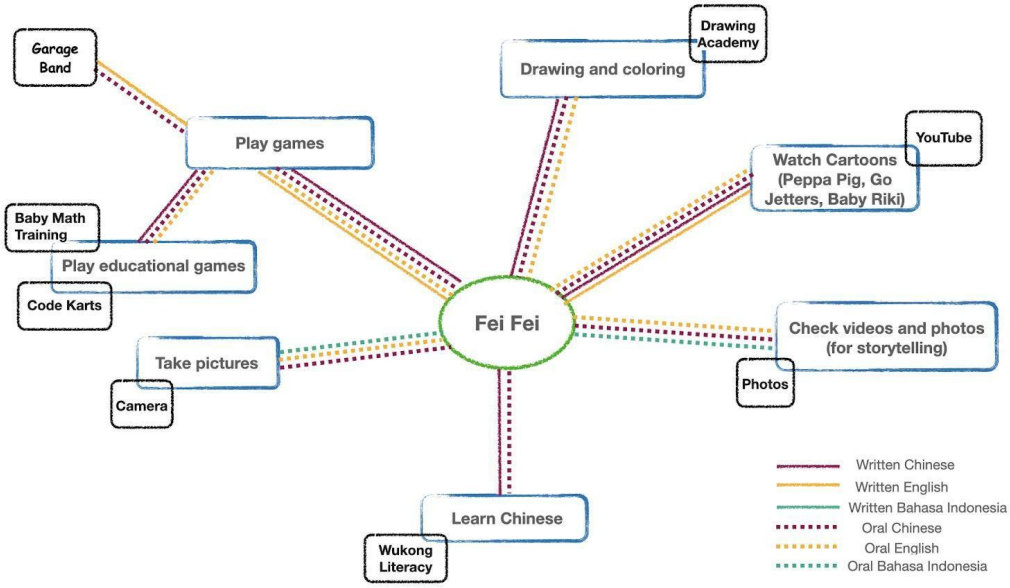

Image 2 Feifei's first mediagram

The first mediagram was created by using information from the first interview with Feifei and her mother and her father's notes sent to me online after that interview. In the first mediagram, Feifei used oral Chinese during all her touchscreen activities, and Chinese was the language setting for almost all the apps she used on her iPad. She was exposed to written Chinese while using several apps captured in the mediagram. English was used orally in some of the activities with her mother, and Feifei only came across written English when she was using the music app *Garage Band* and viewing

cartoons on *YouTube*. Besides, Bahasa was only orally used in two activities, which were taking pictures and checking videos and photos. The patterns of Feifei's language use in her touchscreen activities could be largely influenced by her different parental attitudes towards touchscreen adoption. Studies have pointed out that positive parental attitudes towards touchscreen technology may facilitate more children's touchscreen use (Chaudron et al., 2019).

When talking about playing games on a touchscreen, the mother said in the first interview that:

> "*Because I don't like her to play games, actually. So, my husband has video games for her, it's in Mandarin and the instructions are in Mandarin. (Quote 4.1.17)*"

Most of Feifei's touchscreen apps were downloaded and played in the Chinese setting. For the mother, she did not want to play digital games with Feifei, but she respected her husband's choice of playing some Chinese games on the iPad with the girl.

However, she would play the iPad with Feifei under some circumstances. As a recently introduced device by the time of our first interview, playing on the iPad was regarded as a reward if Feifei behaved well or as part of successful toilet training at nursery or at home. Feifei's mother would sometimes accompany her playing iPad gaming apps. As Feifei and her mother discussed in the first interview below:

> *F: When I did well at school, and I, if I didn't wee on my pants, Baba will give me three games.*
> *M: Three games! Oh, okay. That's the thing, if you didn't cry at school, or didn't pee pee your pants at school, Baba will give you three games. Yeah?*
> *F: Yeah!*
> *(Quote 4.1.18)*

As the example shown in the conversation above shows, Feifei was fully aware that she could play iPad if she did well at nursery. For Feifei, her interest in playing gaming apps, drawing, and other activities on the iPad made the use of the iPad a valid reward.

The mother would sometimes also play the iPad together with Feifei if the girl wanted to teach her how to play certain games on the iPad. Instead of digital gaming, the mother said that she preferred to do other activities with Feifei using her mobile phone, such as taking and checking pictures and videos, storytelling, or video calling family.

As for the father, he spent most touchscreen time with Feifei on the iPad, only sometimes using his phone (e.g., facetiming with grandma back in China). Compared to Feifei's mother, he was more open to Feifei's adoption of digital games. More about the father's attitudes and engagement in Feifei's touchscreen use will be discussed in 4.1.3.3.

Among all the touchscreen activities in the first mediagram, while the father accompanied Feifei most of the time in her touchscreen engagement, two activities involved all three family members and all three oral languages. Similar to the findings of another study on the pre-schoolers' home touchscreen uses in Norway (Dardanou et al., 2020), Feifei sometimes took pictures and checked photos and videos for storytelling. As the mother explained in the first interview:

> *"…She (Feifei) just likes to browse, usually we do storytelling with the mobile phone. We did this like, yesterday we went to the fish shop, we saw the fish, we shot a video, and we tell a story about the video, what's on the video. …… And then, usually at the night-time when we were all together, we tell the story of what we do (did) yesterday or today when we went out. Because my husband is (was) at home, he didn't go there. (Quote 4.1.19)"*

As the mother said above, the family did storytelling with the help of their self-recorded videos, mostly before going to bed. This activity offered the family opportunities to communicate and share thoughts on their experiences with family members not presented, and the recorded videos/pictures supported both the child and parents to recall and explain about these experiences more vividly. As it is shown in this example, storytelling with the help of a touchscreen was an activity indicating intensive family communication with her mother in both English and Bahasa while checking their videos and pictures.

The intensive parent-child interaction was a vital feature of the family's storytelling activity and some other touchscreen activities of Feifei. Some previous studies indicate that high-quality parent-child interaction during touchscreen-using activities may facilitate children's literacy development positively (Kucirkova et al., 2013; Neumann, 2016; Sheehan et al., 2019). Although different voices are raised to show concerns of the negative connections of more digital time and less parent-child interaction (Hiniker et al., 2018; Kildare & Middlemiss, 2017),during the intensive parent-child interaction during some touchscreen activities in Feifei's case, multiple languages were used and practised actively during these activities. More examples of parent-child interactions in Feifei's touchscreen use will be discussed in section 4.1.3.3.

4.1.3.2 Feifei's second mediagram

The second mediagram was edited after conducting the second interview and discussing the first set of parent-recorded videos with the family. Comparing to the first mediagram, Feifei's touchscreen activities did not change much. Only one new activity mentioned by the mother was added, which is making video calls with the families back in Indonesia, using both oral Bahasa and English. Just like the storytelling activity, intensive communication could be found during this video call activity. Another change was that Feifei stopped using the music app *Garage Band* since she was no longer interested in it.

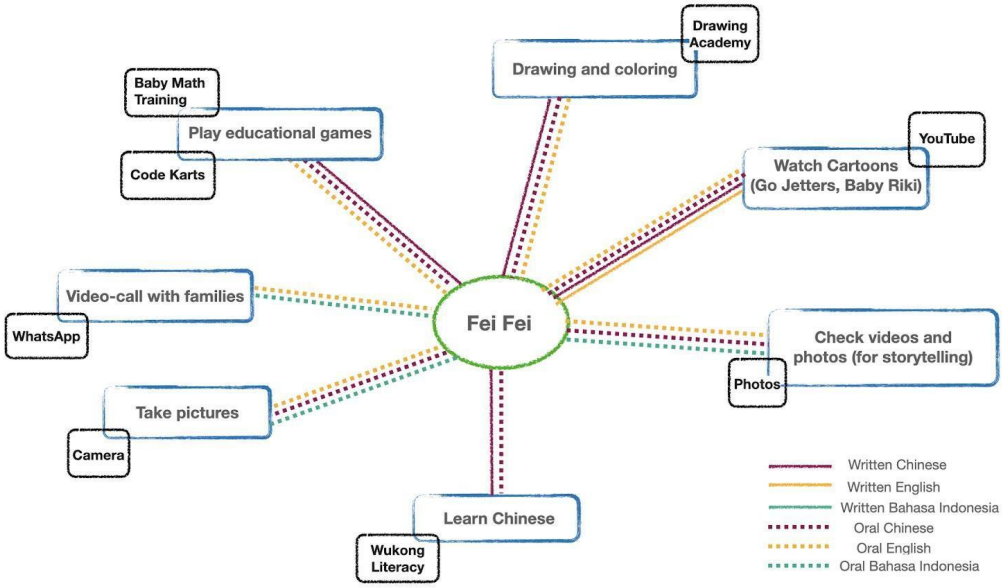

Image 3 Feifei's second mediagram

As the parent who accompanied Feifei during almost every touchscreen activity, the father mentioned some parental mediation (PM) (Zaman et al., 2016) methods related to their language use during the second interview.

Most of Feifei's iPad-use activities were highly monitored and selected by her father. And her father said that he would accompany the girl during almost all her iPad time. Feifei's father carefully selected all the apps and contents for her touchscreen activities. Her father would play a game first before letting the girl access it. For example, when talking about some apps that he had downloaded on iPad but had not let Feifei play, the father said in the second interview:

> "*我可能会等她四岁左右，因为这里面是拼音和数学，我还没有自己玩过，等我自己玩过我觉得适合她了我再去给她玩 [Maybe I would wait until she is around four years old, because there are Pinyin and Maths in these (apps); I haven't played them myself, I would first play myself and let her play (the apps) when I think (the games are) suitable for her]。(Quote 4.1.20)*"

Meanwhile, similar parental supervision on the selection of the contents of Feifei's touchscreen gaming time also appeared in Feifei's screen-viewing activity. For example, the father carefully chose cartoons for Feifei to watch on TV when drinking milk. When we discussed this, he explained that:

> "*注意它的内容吧 [(I) Pay attention to its content]。… 那个瑞奇宝宝呢是俄罗斯一个做的比较好的一个动画片 [Ricky Baby is a well-designed Russian cartoon]。对，它是小孩子可以看的 [Yes, it is for children to watch]。然后呢我们开始觉得，这个小猪佩奇不是特别好，因为我们觉得里面有些东西，有些行为不是特别好 [Then we started to think (the content of) Peppa Pig is not very good, because we think that some behaviours in it are not very good。] 所以我们会给她选，现在也看的小猪佩奇比较少了 [So we would select for her, (she) watches few Peppa Pig now]。(Quote 4.1.21)"*

As the father said, one reason for the parental supervision was that they paid attention to the contents that Feifei would be exposed to. They worried about Feifei's potential exposure to inappropriate content and possible bad influences. The selection of screen content can be seen as a restrictive mediation strategy (Zaman et al., 2016), which helps the parents alleviate the negative effects on children's multiple developments (Mendoza, 2009). However, while the contents of Feifei's screen-viewing activity were carefully selected and altered in the second mediagram, the language used during this activity did not change compared to the first mediagram. As her father reflected in the second interview, "*她动画片会看，M 会给她看英文，偶尔会给她看中文 [She would watch cartoons, M (her mother) would let her watch (cartoons) in English, sometimes (she would) let her watch (cartoons) in Chinese]。(Quote 4.1.22)"* Feifei was exposed to both English and Chinese environments during her screen-viewing activity. Similarly, although the contents of her screen-viewing activity changed again by the time of the third mediagram, the language use remained the same.

Moreover, as these examples showed, this pattern of high parental supervision and selection of apps may reduce the entertaining part and increase the educational purpose in Feifei's touchscreen use. Studies indicate that parents prefer choosing games with specific goals to help their children's literacy development, and they consider the apps as both entertaining and educational (Little, 2020). In Feifei's case, one of her most frequently-used apps was *Wukong Chinese*, which was specifically designed to help children learn more Chinese characters and expressions (details of this app use will be explained in 4.1.3.3).

In Feifei's case, PM did not mean only restrictive parental supervision, it also involved active mediation and co-use activities (Zaman et al., 2016). For example, as her father said, *"就是她如果想玩什么游戏她会问我，然后呢，如果问完我，问完我我给她打开之后呢，我会让她自己去试错 [It's just that she will ask me if she wants to play game; and then, after (she) asks me and I opened it for her, then I will let her trial the error]。(Quote 4.1.23)"*

Although Feifei was used to asking for her father's permission to open a game, her father would encourage her to try to play the games according to her own thoughts instead of always telling her the right answers. Similarly, her mother would also give Feifei freedom to take pictures and choose to tell stories as she liked. Therefore, it could be argued that the parental accompaniment should be seen as not always restrictive supervision but also active mediation and co-use during these family screen activities. One example of active parental mediation and co-use activity was found in the first set of parent-recorded videos:

> *(Feifei was sitting on the bed and playing the app Wukong Literacy on the iPad. Her father accompanied her aside. There was a quiz game of choosing Chinese characters shown on the screen with some animation and sound hints.)*
>
> *B (Background voice): 牛，黄牛 [Cow, yellow cow]。牛，黄牛 [Cow, yellow cow]。*
>
> *F (Feifei listened carefully, looked at the screen and touched the right character on the screen, but there was no response. She pulled her father and said) 帮我，帮我 [Help me, help me]。*
>
> *D：用力按，你点的是对的 [Press harder, you pressed the correct one]。*
>
> *B (with music and animation): 牛，黄牛 [Cow, yellow cow]。*
>
> *(Feifei looked at the screen and touched the right characters on the screen again). (She did it correctly and the screen content changed to another slide.)*
> *(Quote 4.1.24)*

Image 4 Feifei playing Wukong Literacy

In this example, Feifei was playing a touchscreen game with her father's help. When she met difficulties and asked for her father's help, her father did not operate the screen himself; instead, he responded to Feifei and encouraged her to try and press again since she already knew the correct answer.

Parents play a crucial role in facilitating children's proper access to digital contents and their HL development through careful selection and the co-use of certain digital resources (Little, 2020). In Feifei's case, the selection of content and the parental accompaniment during her screen time were the main actions that the parents took to fulfil their role as gatekeepers. Meanwhile, the parents also let the child explore on her own during these activities with parent-child interactions in multiple languages. Active parent-child collaboration can be seen during these family digital activities (Scott, 2022).

4.1.3.3 Feifei's third mediagram

Compared to the second mediagram, Feifei's touchscreen activities and language use did not change much in the third mediagram. One more app was added to the activity of making video calls with family members, and Chinese was also added to this activity. Because the father recalled that Feifei would also make video calls with her Chinese grandparents in Chinese, but not frequently. A new educational app called *Wukong Maths* was added to Feifei's touchscreen use; this app was also downloaded in Chinese.

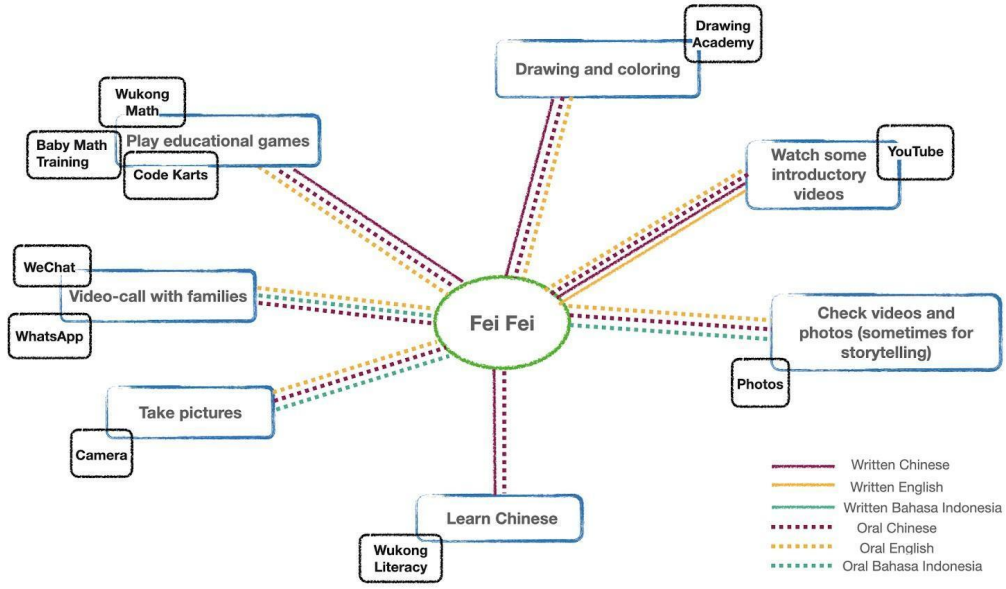

Image 5 Feifei's third mediagram

In the third interview, the father expressed more positive attitudes towards touchscreen use to facilitate Feifei's digital literacy development. He believed that some iPad games could make the process of learning Chinese more interesting. For example, one of Feifei's most frequently used apps was *Wukong Chinese*. Her father said in the second interview that, *"会给汉字一些故事，比如说这个山的形状啊，它讲的基本上都是象形字 [(This app) would make up some stories for Chinese characters, such as the shape of the mountain; it basically teaches pictographs]。(Quote 4.1.25)"* With the animations and stories of Chinese characters, he believed that the use of this app could boost Feifei's interest in learning more Chinese characters.

Besides, as illustrated in the example extracted from the second set of parent-recorded videos below, the well-designed animation and sound effects of these apps could make the learning process more interesting and encourage the girl to continue.

> *B (with sound and animation effect):今天是个什么日子 [What day is today]？*
>
> *F (Feifei looks at the Chinese sentence on the screen and says): 三月三十日 [30th March]。*
>
> *B (the recorder inside the app plays what Feifei just said with animation): 三月三十日 [30th March]。*
>
> *(The touchscreen shows animations with some smiling faces jumping on top of the Chinese characters.)*
>
> *F (Feifei looks at her father and says): 看都在笑 [Look, (they are) all smiling]。*

D: 嘿嘿嘿，对，都在笑，是的 [Hahaha, yes, all smiling, yes]。

F (Feifei smiles and says): 我说的是对的 [(Because) what I said is correct]。

(Quote 4.1.26)

Looking through the lens of the bioecological model (Bronfenbrenner & Morris, 2006), this activity above involves parent-child interactions and Feifei's independent engagements with touchscreens. Feifei first interacted with the sound and animation effects of the app independently. Then, with inspiring animation effects like the smiling faces shown on the screen, she talked to her father to show that she was happy and proud that she could read the sentence shown on the screen correctly. In addition, both interactions are bidirectional (Tong & An, 2024) and can facilitate her Chinese development. In addition, both examples of *Quote 4.1.24* and *Quote 4.1.26* demonstrated Feifei's agency when engaging with touchscreen apps; she performed her agency through direct physical interactions with touchscreens (Peebles et al., 2018; Russo-Johnson et al., 2017) (e.g., tapping with her fingers) and developed her Chinese skills (learning outcomes) with the help of the immediate responses from touchscreens (Kucirkova, 2019; Peebles et al., 2018).

The responsive and touchable features of touchscreens offer an opportunity for the child to write/draw and interact with the screen (Dowdall, 2019). Just as an example her father mentioned during the third interview, in another game, *Wukong Maths*, Feifei liked to follow the arrows and animations to write/draw numbers on the screen. As he said in the third interview, *"比如说，一个 7 字，它会让上面涂涂完泥巴 [For example, there is a number 7 (on the screen), and mud is put on it]。涂完泥巴之后你把它洗干净，照着把泥巴洗掉，这样呢你就得到了一个没有泥巴的 7 字 [After putting mud on it, you (use the finger to wipe the screen) wash it clean, follow (the arrow) and wash the mud off; then you can get a 7 without mud]。(Quote 4.1.27)"* This kind of interaction with the touchscreen made the child feel entertained and had an impression of that number while listening and reading Chinese instructions.

Different from traditional screen or media time, devices such as an iPad, with a larger touchscreen and integrating multiple technological features into one device, could provide more responsive interactions with children (Chowsomchat et al., 2023). While playing gaming apps, the boundaries between amusement and efforts for language learning are not clearly divided (Little, 2020). In Feifei's case, her use of the iPad was both entertaining and educational, especially for her development of Chinese.

Looking into all three mediagrams, they visualise Feifei's multilingual language uses during her varied touchscreen activities. The most frequent language exposures relating to her touchscreen activities were the oral ones. Oral Chinese was used in all her touchscreen activities, and it was a significant feature of her home touchscreen use pattern. Another HL of Feifei, Bahasa, was used only in three touchscreen activities that her mother sometimes participated in, so Bahasa is essentially linked to her mother and remote family only. Except occasional exposure to written English when watching some *YouTube* videos, Feifei's main written exposure and language use during touchscreen time was in Chinese. Therefore, it can be argued that most inputs and outputs were three oral languages, including listening and speaking, and the use of Chinese played a dominant role in most of her touchscreen use activities. As for the written language, only written Chinese was practised during Feifei's use of some well-designed Chinese apps; no written Bahasa or English were developed on purpose throughout her touchscreen use.

However, it should be mentioned that touchscreen was only one tool for Feifei to practise and develop her languages. The parents also helped Feifei develop her trilingual languages through other family activities. As the father said in the third interview, "*中文的话我到没有太依赖 iPad，但是呢它这几个游戏确实还不错 [For (developing) Chinese, I did not rely too much on the iPad, however these games on the iPad are quite good]。中文的主要是我平常会注意跟她多交流 [For (developing) Chinese, I usually pay attention to communicate more with her]。(Quote 4.1.28)*"

Similar to the strategies of Feifei's mother mentioned previously, Feifei's oral Chinese acquisition was stressed in daily life (e.g., repetition). The father taught Feifei Chinese in non-digital ways, such as using physical flashcards, while using iPad games as a complement.

4.1.4 Summary

From the case study of Feifei's family, the young trilingual girl developed rather stable language habits at home. She could clearly distinguish the three languages and switch languages when talking to different people who spoke different languages. She spoke mostly English and began to learn some Bahasa with her mother, and she mostly spoke Chinese with her father. She was happy to learn and speak all three languages, which indicated that she was positive towards her trilingual language identity and maintaining her HLs. Moreover, her multilingual language choices and habits were closely related to parental language attitudes, her own emotional preferences, and her varied levels of language capacities in the three languages.

The varied parental FLP strategies mentioned above influence Feifei's language choice and communication habits. Combining both the parental and the child's language choices and attitudes, it could be argued that Feifei's acquisition of two HLs was stressed in her FLP, especially the oral language skills. Through daily communications and family literacy activities, HLs are developed gradually (Kupisch & Rothman, 2018). The girl developed both languages through mostly daily communication with her parents in a natural environment, in both digital and non-digital activities. As mentioned above, the parents worried less about Feifei's English development as she was exposed to an English environment a lot during the data collection period. Therefore, the natural home environment seemed to play a vital role in Feifei's multilingual language development, and the parents put a priority on Feifei HL developments compared to the dominant language, English.

Viewing Feifei's trilingual literacy development during her home touchscreen practices, the adoption of touchscreen had its own unique features to help her develop her oral and written Chinese skills in a motivated and entertaining way. And it also offered opportunities for her to practise oral English and Bahasa skills through some touchscreen activities. The well-designed educational games may facilitate digital literacy development with the help of interactive sound and animation effects in the apps. While acknowledging the entertaining and interactive features of these apps, parent-child interactions and parental mediation in Feifei's case played a significant role during her touchscreen time and other family activities. The intensive parent-child interactions in both digital and non-digital activities facilitated the child's HL development. It needed to be acknowledged that the touchscreen adoption of Feifei was only one complementary way for her to develop the languages in her daily life; her trilingual language developments were closely related to other activities, such as daily family communication, and some non-digital games and activities.

4.2 Mango's case study

4.2.1 Introducing Mango's case

Mango was a six-year-old boy who was born and raised in southern England, and he lived with his parents. Both his parents were Chinese, and he spoke Chinese and English during his daily family communication. During the data collection period, he regarded himself as a trilingual child who can speak three languages: Chinese, English, and French. However, French was not a language he practised frequently in his daily life. By the time of our first interview, he was about six and a half years old and turned seven years old before having the second interview. Mango had already been in a primary school by the time of our first interview and had entered a private junior school by the time of our second interview after he passed his 7 plus exam. The family was recruited through the snowball method (Noy, 2008), word of mouth. The mother expressed her interest in participating in this study. The information letter and consent form were sent to the mother, and a phone call was made between the mother and me to explain more detail of the study. The study was conducted after receiving the signed consent form from the parents, and Mango's oral assent was obtained each time before and during the interviews.

The total length of the three family interviews with Mango's family was about 2.5 hours. The first and third interviews were conducted with Mango and his mother, as Mango's father was busy at work and always not at home. The second interview was conducted with Mango's mother because Mango needed to attend a class due to a sudden change of plan on our scheduled interview time, and the mother insisted on having the interview on time. The interval between the first and second interviews was about three and a half months, and the interval between the second and third interviews was around two and a half months. Parent-recorded videos were sent to me between the interviews (2 videos, about 5 minutes in total). The first mediagram was drawn after having the first interview, and the other two mediagrams were developed with the family after discussing the parent-recorded videos and the former mediagram during the interviews. Besides, two language portrait activities (LP) were conducted with the child. The first LP was conducted and recorded by Mango's mother and him without my presence before the first interview, because during our first phone call, the mother was worried that Mango could be too shy to do this activity with a stranger and she would like to conduct the activity herself with him. The second LP was conducted during the third interview since Mango became more familiar with me, and he asked to redo the LP himself after the second interview through online chat.

4.2.2 Mango's language choice

Mango's language use patterns are analysed below with the demonstration of the two LP pictures and other data from the interviews with Mango's family.

4.2.2.1 Language portrait (LP)

As mentioned in the introduction section, Mango did two LP activities. One was done with his mother before the first interview, and another was done with his mother and me during the third interview. The LP activity is effective in assisting children to demonstrate their diverse linguistic backgrounds as well as their awareness of language identities by biographically visualising the participants' linguistic repertoires (Soares et al., 2020). For Mango, he did the two LP activities differently and represented varied understandings of his perceptions of languages; the two paintings are demonstrated below.

In the first LP, the child did not regard the body silhouette image as himself but as another person he imagined. However, he did remember some rules of this activity; when the mother asked about the link between colours and language, he could answer it. Here is a conversation clip between him and his mother during the first LP.

> *Z (Mango): 他的 shoes 是 French，because 他 brown shoes 就会很像我那个 school shoes [His shoes are (painted in the colour represents) French, because his brown shoes, it would be very alike my school shoes]。所以他那个 [So he (goes to school)], this is his school uniform. It's jeans and short sleeves.*
> *M (Mango's mother): Do you know that person means you? Or do you want to make another person?*
> *Z: I want to make another person.*
> *(Quote 4.2.1)*

In this example, he linked the colour brown with French and wanted to paint for another person he imagined. He did not link the colours with languages all the time. When his mother asked about why he painted the red top, he said, *"(If you do not paint the top red), 就没有这个 colour [this colour will not be (in the painting)]，you are wasting colour. (Quote 4.2.2)"* He asked to redo this activity and reflected more on his languages in the second LP.

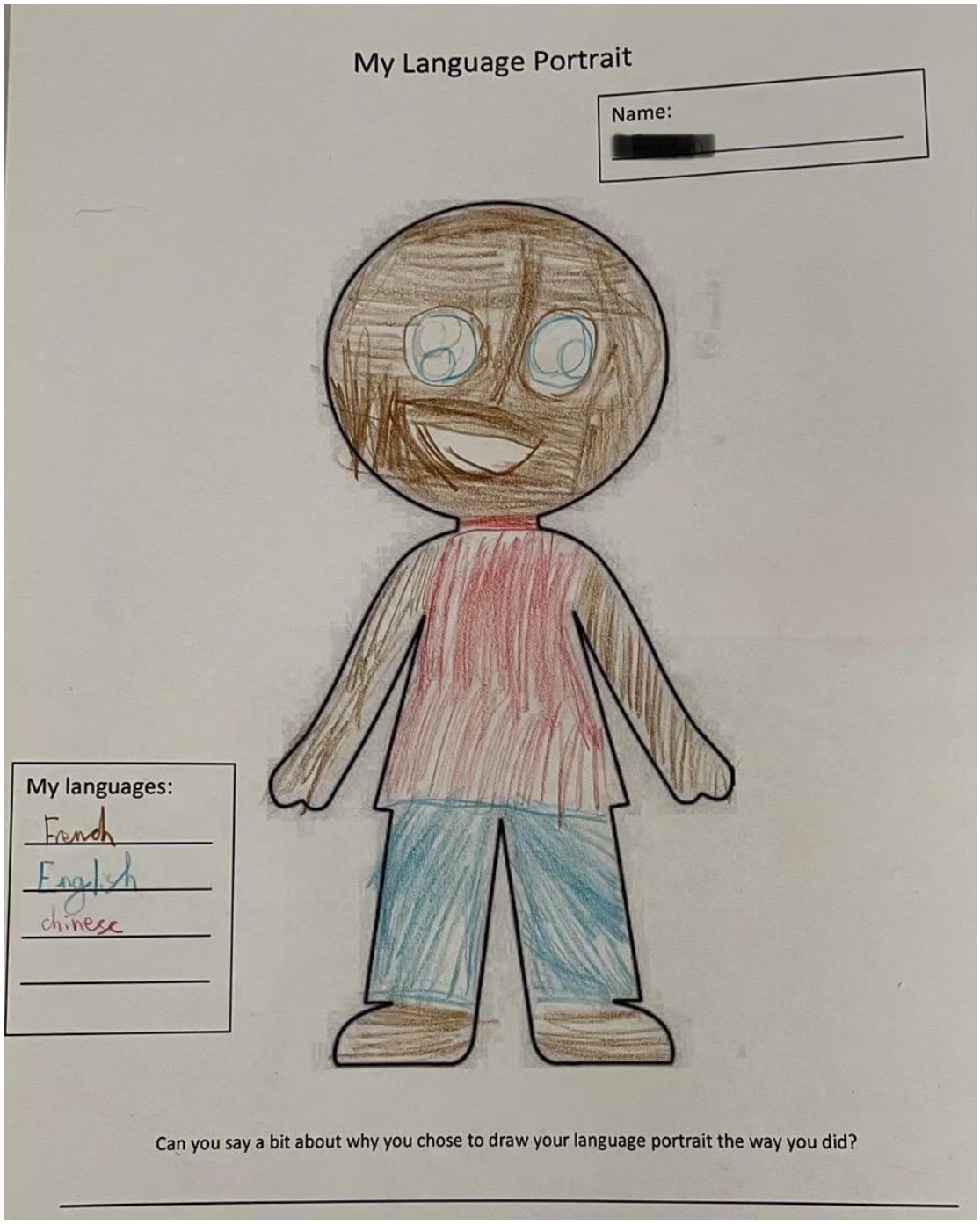

Image 6 Mango's first language portrait

In the second LP, he imagined this body silhouette as himself and explained more about his thinking.

> *R (Researcher)：你可以跟我们分享一下你为什么想要这样涂色吗 [Could you share with us why you want to paint like this]？给我们简单的讲一讲吧 [Tell us briefly]。*
>
> *Z：因为我喜欢那个，middle 的颜色，Chinese [Because I like that, colour in the middle, Chinese]。然后外面的颜色English，还有然后那个上面的会French [Then the colour (painted) outside is English, and then the upper part (i.e., the head part*

in this painting) knows French]。

……

R：那你的五官呢 [How about your facial features]？你的眼睛，鼻子和嘴巴 [Your eyes, nose and mouth]？

Z：我的鼻子是 green，然后我的眼睛是红色，还有我的嘴巴是红色 [My nose is green, then my eyes are red, and my mouth is red]。然后我两个咪咪是黄色，然后我的 belly button 是黄色 [Then my two mimi (it means nipples) are yellow, then my belly button is yellow]。

(Quote 4.2.3)

In this conversation, Mango clearly linked all three languages with the three colours he chose, and he explained in detail how he painted the details of the body silhouette with different colours. Combining the findings from both LPs, Mango believed that he was a trilingual child. While English and Chinese were used in his daily communication, French was only used during his French classes with his French teacher. As we discussed in the first interview, Mango could distinguish the languages he could speak and which situations each language applied:

R：首先我们来聊一聊你在家里和爸爸妈妈都会说哪些语言呀 [First, let's talk about what languages do you speak at home with your mother and father]？

Z：我们会说中文还有英文 [We speak Chinese and English]。

R：那你会说几种语言呀 [So how many languages can you speak]？

Z：三个 [Three]。

R：三个，还有什么语言呀 [Three, what is the other language]？

Z: French.

R: French, ok. So, it's Chinese, English and French, right?

Z：对的 [Yes]。

R：Ok. 那你平时会跟什么人讲 French 呢 [So who do you normally speak French with]？

Z：跟学校里的人 [With people in school]。

R：学校里的人 [People in school]，Ok. 是你的老师还有小朋友们吗 [Are they your teachers and friends]？

Z：是老师 [It is the teacher]。

R：老师 [The teacher]。所以老师上课的时候会跟你用 French 对话，对吗 [So the teacher speaks French with you during classes, is it]？

Z：是我跟老师说 [It is me talking to the teacher (in French)]。

R：啊是你跟老师用 French [Oh, it is you talking to the teacher in French]。

(Quote 4.2.4)

From the above conversation clip, Mango said that he was used to communicating in Chinese and English with his parents, while he voluntarily spoke French to his teacher who can understand French at school. It was interesting that Mango considered French as a vital part of his language identity, even though French was rarely used in his daily

life. In the second LP, he even explained that he painted his private parts of the body with the colour that represents French, which indicated the importance of this language to him and part of his emotional preferences of languages (Dekeyser & Agirdag, 2021). Although the boy mastered and used the three languages to different levels, they were all important to him and inseparable from his linguistic repertoire.

The above two LP activities indicated that Mango could distinguish the three languages. While French was only practised at school with some teachers, he mainly used Chinese and English to communicate with family daily. In addition, as the wavy lines in these above examples demonstrated, Mango sometimes combined English and Chinese in one sentence, which meant that translanguaging (Charamba, 2020) was one typical feature in his daily conversation. More about this language choice will be analysed in the following sections.

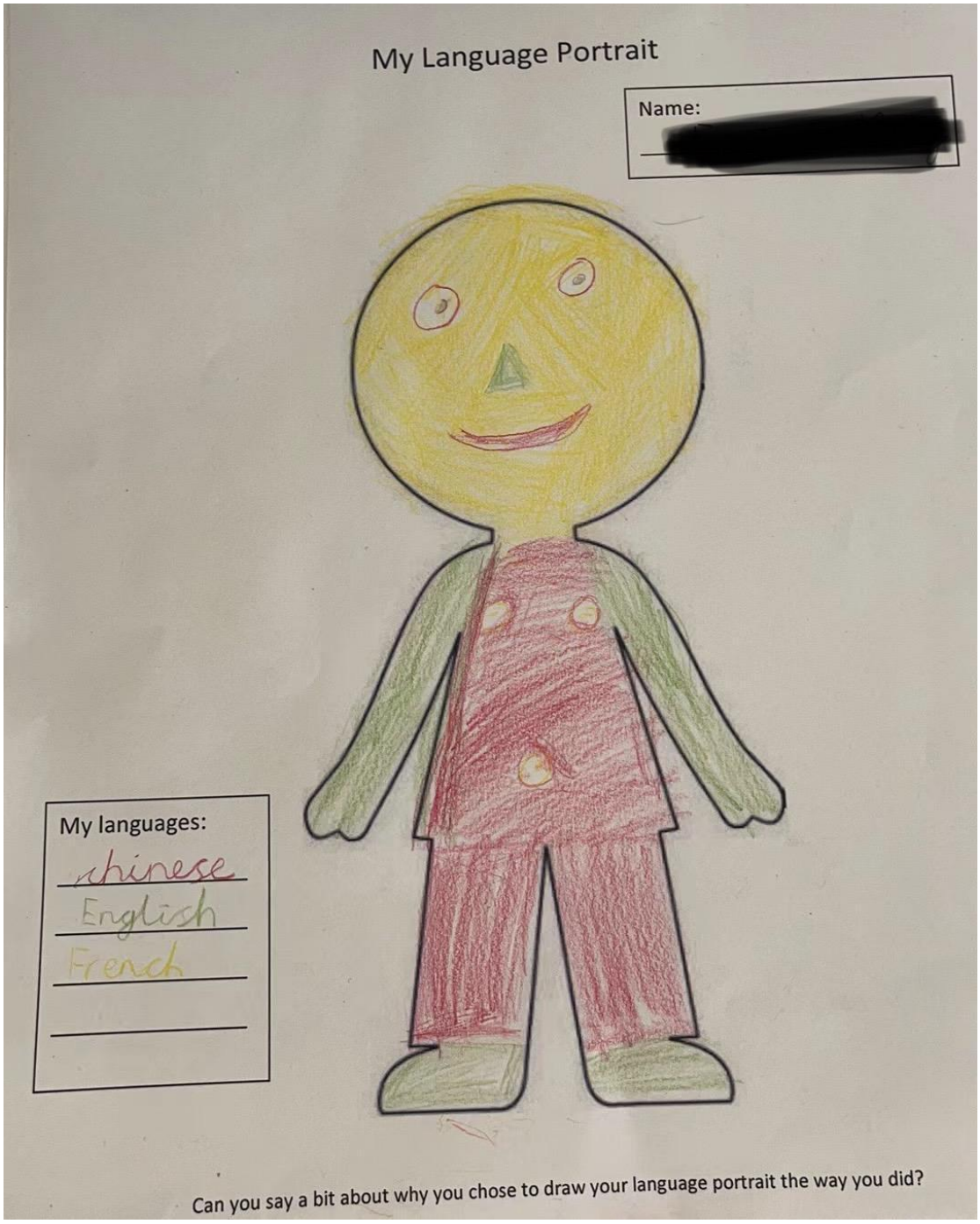

Image 7 Mango's second language portrait

4.2.2.2 Family language policy (FLP)

From the above LP conversation examples and other data collected, one significant feature of Mango's language use was that he often interwove English and Chinese into one sentence. Mango sometimes did not speak with the correct grammar in both languages, and he would miss words when making a sentence. These language habits may be influenced by the ways in which the two languages were introduced to him, and the family language policy (FLP) (Wilson, 2020) plays a vital role in it. As his mother recalled in the second interview,

> *"因为他小的时候我是想让他学中文的，所以我小时候是跟他说中文的是没有英文的 [Because when he was little I wanted him to learn Chinese, I only spoke*

Chinese with him, no English]。但是呢后来我发现，可能是因为我说话的习惯 [However, later I found that, maybe it is because of my speaking habits]。你知道在这边久了你有时候就会不自觉的中英文混着在一起说 [You know, if you live in here (i.e., England) for a long time, sometimes you mix Chinese and English together unconsciously when speaking]。……我们大概尽量说的是中文，大概有百分之八十是中文 [We tried to speak Chinese most of the time, about 80% (communication) were in Chinese]。(Quote 4.2.5)"

In early childhood, the home environment and parents play vital roles (Bronfenbrenner, 1979) in facilitating young bilinguals to develop their languages. The mother wanted Mango to maintain and speak fluent Chinese from a young age, so their FLP was to speak as much Chinese as the parents could with Mango. However, she sometimes mixed English and Chinese herself in her daily communication. The translanguaging language habit of the parent may largely influence the child's emergent language choice (Song, 2016; Karpava et al., 2021).

However, Mango's translanguaging language use raised concerns; the mother believed that it became complicated since Mango needed to prepare for school entry exams. As she said in the second interview:

"我发现了一个很大的问题就是，他因为要考七加，他们七岁的时候有一个考试，然后那个考试需要有阅读理解和作文 [A very big problem I find is that, because he needs to take the 7 plus exam, they have an exam at age seven, and the exam needs to (test) reading comprehension and composition]。然后我发现他的英文语法非常的混乱，他的英文是用中文的语法去说，或者是他的语序非常的混乱，就是他把两种语言其实有点 mix 了 [Then I found that his English grammar was very messy, his spoke English n Chinese grammar, or his word order was very confusing, he actually kind of mixed the two languages]。而且我发现给他解释东西的时候，我不能用单独一个语言给他解释清楚东西 [And I find that when I explained things to him, I cannot explain it clearly to him in only one language]。(Quote 4.2.6)"

The translanguaging feature of Mango's bilingual language use could weaken his performance in the school entrance exam. To help Mango pass this exam, Mango's parents had altered their original FLP.

First, the parents decided to change their language habit of mixing the two languages with caution. As the mother said in the second interview, *"我跟我老公说，我们给他解释东西的时候不可以混着说，你要不然就是用全中文，要不然就是全英文 [I told my husband, we cannot mix (the languages) when we explain things to him (Mango), you use complete Chinese or complete English]。(Quote 4.2.7)"* The parents had maintained this new habit by the time of our third interview.

Then, another change in their FLP was also related to the pressure of Mango's school performance. The parents switched to speaking mainly English with Mango when explaining school-related tasks to Mango. For example, the parents found it tricky to explain maths questions or knowledge to Mango in Chinese because he learnt it in

English at school, so they needed to explain it to him in only English. They even stopped Mango's Chinese community school course because of the school entry exam.

For HL-speaking children, entering school is a vital point of time, they need to fulfil a series of school goals using the dominant language in society, and this may affect their FLPs. They may have to reduce the amount of HL exposure for better school performance in the dominant language, regardless of the positive influences of HLs on motivating the child to develop multilingual literacy and language identity (Little, 2019; Stewart, 2017). Mango's case told a similar story; the parents found it challenging for Mango to develop both the Chinese and English at the same time when facing academic pressures. They changed their FLP and put more stress on speaking and helping Mango practise his English skills to pass the entry exam.

As mentioned above, the FLP in Mango's family was altered by the parents most of the time; however, this did not mean that Mango was a passive receiver of his parents' language management strategies (Wilson, 2020). Although the FLP changed and more English was spoken to Mango, he would still set his own language rule sometime. In the third interview, the mother said that,

> *"他特别喜欢说中文 [He loves to speak Chinese]。有的时候他说，让我们不可以说英文和法语，只可以说中文 [Sometimes he says, we cannot speak English or French, (we) can only speak Chinese]。就是他会规定一些这些 rules [He would stipulate these rules]。(Quote 4.2.8)"*

Making rules for only speaking Chinese with the parents indicated Mango's children's agency in choosing the languages he liked to speak (Shen & Jiang, 2023). Mango played an active role in forming the FLP (Wilson, 2020) by showing his language preferences during communication and negotiation with the parents (Roberts, 2023). Associated with his LP painting, Mango was aware positive to maintain Chinese, and the following conversation explained more about this:

> *M：他以前跟我说，他觉得中文其他人都听不懂，他觉得这个语言很酷，这个可能是他的原因之一 [He used to tell me, he think that other people cannot understand Chinese, and he thought this language was cool, that was probably one of his reasons (to like Chinese)]。*
>
> *R：Mango，你为什么喜欢说中文呀 [why do you like speaking Chinese]？*
>
> *Z：喜欢说中文，因为别人就听不懂我 [(I) like speaking Chinese, because others cannot know what I say]。*
>
> *(Quote 4.2.9)*

For Mango, Chinese was a language that only family members could understand; he felt that speaking Chinese was mysterious, and he enjoyed speaking Chinese when he had an option. For example, Mango preferred to speak Chinese with me when I asked about the language that he preferred to communicate with me. He felt positive about his HL and was willing to maintain this language himself, even after the change of parental language management for better school performance. Similarly, as discussed above, Mango also showed interests in French, which he emphasised in his LP activities and the interviews. Although none of his parents spoke French, he showed a positive attitude and practised this language with his teacher in school.

From the bioecological perspective (Bronfenbrenner & Morris, 2006), Mango's

Chinese development was closely related to parent-child interactions in microsystems, and his English was developed through interactions in both home and school environments. Looking into all four properties in the PPCT model, Mango's bilingual developmental outcomes were influenced by these elements in a synergistic way (Navarro et al., 2022; Siraj & Huang, 2020). First, the Person characteristics of both parents and Mango influenced his language practices at home. Mango's mother mentioned a change of the languages they used to talk to Mango (from mostly Chinese to both Chinese and English) to prepare Mango for the school entry exam in English (forces and resources). For Mango, different from his mother, he was more positive about developing Chinese (forces) and sometimes set rules to only speak Chinese at home (forces and resources). The translanguaging practices also demonstrated Mango's skills of using his entire linguistic repertoire creatively (Wei, 2018) during interpersonal interactions (resources). Second, along with the influence of the characteristics of Person, the change of Context and Time also greatly influence a person's development (Bronfenbrenner & Morris, 2006). The school pressure in English and the transition from primary to junior school influenced Mango's bilingual development.

4.2.3 Evolving mediagrams

Mango's home touchscreen activities varied and changed during the different periods of data collection. These activities are clearly demonstrated in the three mediagrams. To thoroughly understand Mango's touchscreen adoption patterns, detailed analysis is illustrated with these mediagrams and data from the parent-recorded videos and family interviews.

4.2.3.1 Mango's first mediagram

The first mediagram was drawn after having the first interview with Mango and his mother. There were four activities that Mango did with touchscreens at home: watching videos on *YouTube*, playing some gaming apps, making video calls with his grandparents back in China, and using an app to study maths.

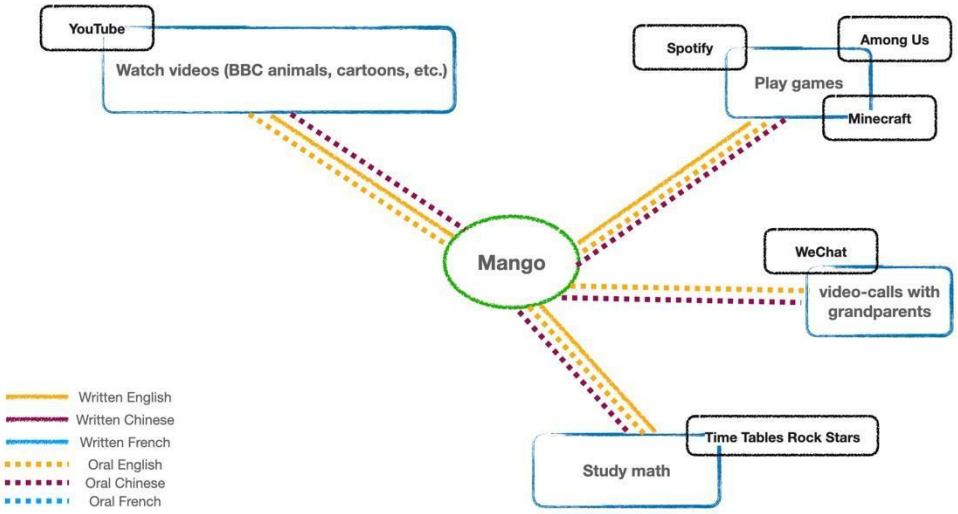

Image 8 Mango's first mediagram

As discussed in the previous section, translanguaging (Song, 2016) was one typical feature of Mango's language use, so oral Chinese and oral English appeared in all four

touchscreen activities. Besides, as the mother said in the first interview, *"应该都是英文的，他的 app [His apps should all be in English version]。(Quote 4.2.10)"* Therefore, except for the video call activity, in which the mother said that Mango would only speak some words with his grandparents while she operated app, written English exposure appeared in almost all his touchscreen activities.

Similar to the video call activity, Mango's parents sometimes accompanied him while he watched videos and studied maths. As the following conversation from the first interview indicates:

R: 你有喜欢看的 BBC 的东西吗 [Do you like anything you watch from BBC]？
Z: About leopards.
R：Leopards. 是豹子吗 [Are they Baozi (i.e. the word leopards in Chinese)]？
(Mango nods.)
R：那你平时用 YouTube 看视频，看 leopards 的时候，爸爸妈妈也会陪你一起吗 [So when you usually watch videos via YouTube, when you watch leopards, will your father and mother accompany you]？
Z：嗯，会 [Hmm, yes]。
R：你大概会多久看，多久看一次 YouTube 呀 [How often do you normally watch YouTube]？
Z: Every week.
(Quote 4.2.11)

During this conversation, while I asked most of the questions in Chinese, Mango answered many of my questions in English and only one in Chinese. This example indicated a different kind of translanguaging took place when he talked. In this example, instead of mixing the two languages into one sentence, he can also understand questions in one language and answer them in another language during a short conversation.

Moreover, for the language use during his touchscreen use, the mother said in the first interview, *"应该是中英和在一起的 [(It) should be (using) Chinese and English together]。(Quote 4.2.12)"* This language feature of parent-child interactions during touchscreen time will be discussed in detail with more examples in the following section.

4.2.3.2 Mango's second mediagram

The second mediagram was drawn after having the second interview with Mango's mother and discussing the first set of parent-recorded videos with her. As illustrated in the second mediagram below, while some activities in the first mediagram remained the same, two new activities were added. Mango would also use his mother's phone to take pictures and check photos and videos.

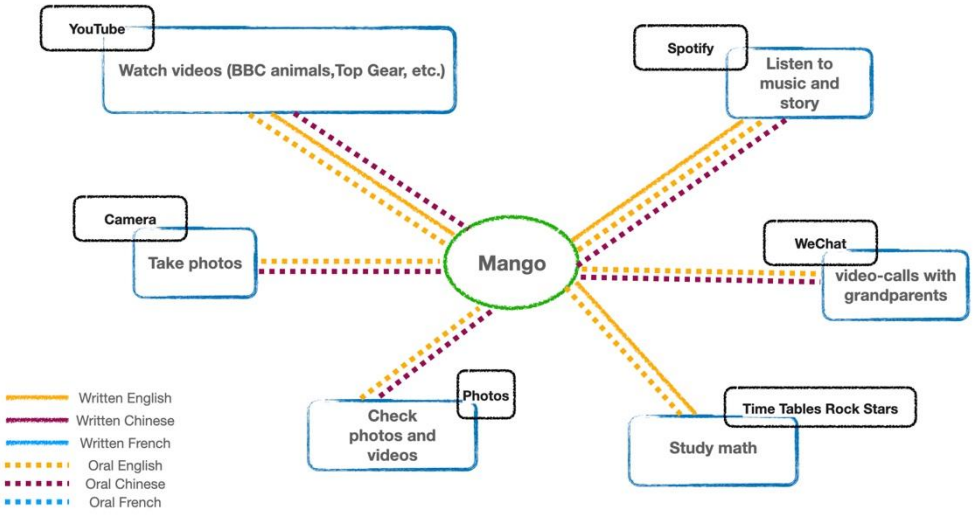

Image 9 Mango's second mediagram

The language used in the newly-added activity can be seen from the following clip extracted from the first parent-recorded video:

> *(Mango and his mother are dining in a restaurant; he is holding his mother's phone and checking the album.)*
> *Z (Mango looks at a photo and shows it to his mother): I like this!*
> *M: 你在干什么 [What are you doing] ?*
> *Z：我也不知道呀 [I do not know]。*
> *(He keeps swiping the screen and check other photos.)*
> *M: 你在 check 你的 picture 吗 [Are you checking your pictures] ?*
> *Z (He touches and swipes the screen): Of course, I am.*
> *……*
> *Z (He uses his finger to touch and scroll the screen to check more photos in the album.) Wow. Look at me. This is T. (He says this while clicking on the photo in the album and opening it.)*
> *(Quote 4.2.13)*

In the above conversation, both oral Chinese and English were used during this photo-checking activity. The mother and Mango spoke in Chinese at the beginning (as the underlines show), and then the mother combined two languages in one sentence (as the wavy line shows). After that, Mango spoke English while checking the photos (see the double underlines).

Another change was that Mango stopped playing the gaming apps called *Minecraft* and *Among Us* by the time of the second interview. He continued using *Sportify* on his mother's phone to listen to music and stories. This change indicated some restrictive parental mediation (PM) (Zaman et al., 2016) of Mango's touchscreen use. Taking the app *Among Us* as an example, the mother expressed her concerns about using this app in the second interview:

> *"那个小红人它叫 Among Us [That little red person (symbol), it is called Among Us]。那个是一个 online 的 game，就别人在网上可以边说话边玩的 [That is an online game, so other people can play online while chatting]。而且它有一些'杀人'的玩*

法，所以我觉得不符合他的年纪，我就没有让他玩了 [Also, it has some 'killing' elements in the game, so I do not think that fits his age; I do not let him play anymore]。(Quote 4.2.14)"

As the mother said, she supervised the app content and told Mango not to play the game because she spotted some inappropriate violent contents in that game. On the app introduction page in the app store, *Among Us* is designed for children aged 9 and above, so the mother's concerns and mediation about Mango's use of this app make sense and show the importance of parents' role as gatekeepers (Little, 2019) for children's touchscreen use. But this PM was not fixed, by the time of the third interview, Mango played this game again and his mother agreed for him to play since he would ask for playing it. She said that *"他有时候会说我想玩那个 Among Us，我说 '你可以玩大概三个比赛，三个 game 就结束了'，他就会同意 [He sometimes would say that I want to play Among Us, I say 'you can play about three rounds, three rounds of the game and finish', he would agree] (Quote 4.2.15)。"*

Instead of prohibiting him from playing it in the second interview, his mother changed the PM strategy in the third interview because Mango insisted on playing this app. The new PM strategy was still restrictive in nature, but it showed respect to Mango's will and was a result of parent-child negotiation. She set rules on the time length of playing this game instead of prohibiting him from playing it. This change of parental mediation showed that Mango's touchscreen use was influenced by both his interests and parental mediation.

However, the change of parental attitudes and respect for Mango's will did not mean that there was less strict restrictive mediation (Zaman et al., 2016) during Mango's touchscreen time. Some of Mango's touchscreen use indicated that parental mediation outweighed the children's will. For example, in the second interview, when talking about the use of *Times Table Rock Star*, an app recommended by his school, his mother said that because this maths app required a lot of thinking, and she set rules to reduce Mango's screen time if Mango wanted to play her phone.

"他有时候知道我说如果你拿我的手机，你只能玩这个 Times Table，他说那我就不拿了 [Sometimes he knows that I would say that if you use my phone, you can only play this Times Table, (then) he would say that I do not want to use it] (Quote 4.2.16)。"

From the negotiation, Mango's mother set a rule for him to use her phone, saying that he could only play the maths app, then let Mango decide whether to use it. Setting rules that are enforced by parents is one feature of restrictive mediation (Zaman et al., 2016). Mango could only decide whether to play that app with providing conditions, which indicated his agency but within limited choices.

As for the PM of the language use during these touchscreen activities, the mother further explained about it in the second interview:

M：如果做作业和解释他学习上的东西的时候是英文 [If (it is for) doing homework and explain things about his study, (I) use English]。

R：就是比如说那个 Times Table 就是会用英文 [For example, (you) use English while playing the Times Table (with Mango)]?

M：对，Times Table 是用英文 [Yes, (we play) the Times Table (app) in English]。

R：那看视频呢 [How about watching videos]？就是什么 Top Gear，他会跟你聊天吗 [Such as Top Gear, would he (Mango) talk to you (when watching it)]？

M：Top Gear 的时候，他会跟我说，但是那个可能就属于生活的用语，就可能就是中英文混着了 [(When watching) Top Gear, he would talk to me, but it is more like the daily communication, (he) may mix both Chinese and English (in one sentence)]。

……

*M：**我会让他尽量就不要混在一起** [I would tell him not to mix (the languages) as much as possible]。**因为他现在就会说，I want to drink some 水** [Because now he may say, 'I want to drink some shui (i.e. pronunciation for the character 'water' in Chinese)']。**然后我就跟他讲，'你可以把这两个分开，因为有一部分别人是听不懂的'** [Then I would tell him, 'you can separate the two (languages when speaking one sentence), because other people may not understand some part of it']。**我会有意的强调让他不要混着说** [I would consciously emphasise that he should not mix (the languages) while speaking]。*

(Quote 4.2.17)

In the above conversation, Mango's mother explained that parent-child interactions and language choices can be different while doing different touchscreen activities. Similar to their FLP discussed in the previous section, using this maths app aimed for Mango's academic needs, and the parents tried to explain academic-related things to Mango in complete English. For example, when using the app *Times Table Rock Star* to study maths (see the change of language exposure in Mango's second mediagram). When communicating in other activities, such as watching videos, translanguaging could still be a typical feature during parent-child interactions. Moreover, as the mother further explained her language management skill with an example in this conversation (see the sentences in bold), she would carefully correct Mango and emphasise the importance of speaking sentences in complete Chinese or English.

4.2.3.3 Mango's third mediagram

The third mediagram was drawn after having the third interview and discussing the second parent-recorded video with Mango and his mother. Compared to the second mediagram, Mango stopped using the app for studying maths as he was not interested in it, and two activities were added in the third mediagram. One was learning Chinese characters using an app called *iHuman Chinese*. Another was playing games. One gaming app was named *Space Rocket Exploration,* and the other was *Among Us*, which was used by the time of the first interview and stopped by the time of the second interview. In addition, the use of touchscreen devices had changed by the time of the third interview. Mango used to do most of his touchscreen activities on his mother's mobile phone previously, but he switched to spending most of his touchscreen time on an iPad by the time of the third interview. Mango also received a Vtech touchscreen watch as his birthday gift. He used this watch to take pictures and check photos and videos instead of using his mother's phone by the time of the third interview.

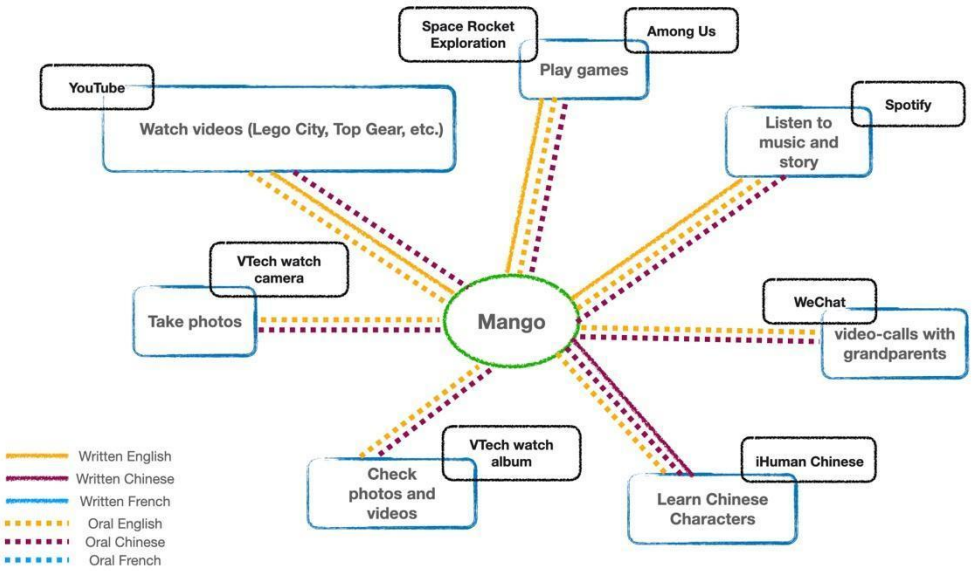

Image 10 Mango's third mediagram

The language used while playing gaming apps was similar to the other previously mentioned activities; both oral English and Chinese were used, while written English appeared since the apps were downloaded in the English versions. However, for the app used for learning Chinese characters, the situation was different. The app, named *iHuman Chinese*, became Mango's most frequently used app by the time of the third interview. While both oral Chinese and English were used during this activity, written Chinese instead of written English was practised when Mango was using this app. Here is a clip transcript extracted from the second parent-record video to illustrate how Mango engaged with this app.

(Mango is playing *iHuman Chinese* on an iPad.)

B (Background voice) (New animations setting with a bear on the left and an animation giving hints on writing the character '上 [up]' show on the right of the screen.): 写 [Write]。快来写一写吧 [Come and write it] 。

B (Mango follows the animation instruction and uses his right index finger to touch and write on the screen. Background voice with sound and animation effects): 竖 [Downward stroke]。

B (Mango follows the animation instruction and uses his right index finger to touch and write on the screen. Background voice with sound and animation effects): 横 [Rightward stroke]。

B (Mango follows the animation instruction and uses his right index finger to touch and write on the screen, Background voice with sound and animation effects): 横 [Rightward stroke]。

B (The bear on the left 'eats' the character he just wrote and turns from grey to orange, and the bear animation 'says' loudly): Yahoo!

Z (Mango looks at the screen continuously and says): Yahoo!

(Quote 4.2.18)

Like the interpersonal interactions, interactions with touchscreens also belong to proximal processes that greatly influence a person's development, and interactions between the developing person and the objects are also bidirectional (Bronfenbrenner

& Morris, 2006; Tong & An, 2024). Children's agency plays a vital role in influencing the child's learning outcomes during touchscreen activities (Kucirkova, 2019). In this example above, when he tried to write the character '*上 [up]*', Mango moved his right index finger according to the hints on the screen. The interactive feature of touchscreen devices offers a chance for children to write or draw directly on the screen (Dowdall, 2019). After Mango finished moving his finger and wrote this character, the sound and animation effects changed on the screen to indicate he wrote the correct character. By independently operating this app, Mango demonstrated his agency during turn-taking activities and through receiving timely feedback from the touchscreen sound and animations (Peebles et al., 2018), and his agency facilitated his learning of new Chinese characters.

Compared to the phone screen, the larger touchscreen of these tablet devices could offer a more user-friendly interface, providing opportunities for children to make multiple creations (Poveda et al., 2020). The bigger screen of the iPad was one reason for his mother to let him change to use this device. His mother said in the third interview that that *"因为洪恩识字那个在我手机里，那个字会变的特别小，很难去控制 [Because (when playing) iHuman Chinese in my phone, the characters would become very small, and it was very hard to control (i.e., write on the screen)]。(Quote 4.2.19)"*

In the following example of this video, Mango expressed more but spoke only in complete English:

> (Mango clicks at the white hand symbol with sounds and animation effect on the screen; a blue butterfly appears at the same place where the white hand animation disappeared.)
> *Z (He looks at the butterfly animation, and the butterfly flies in a circle on the screen with sound and animation. Mango says): Wow, watch the butterfly! Fly, fly, butterfly!*
> *Z:(He keeps looking at the butterfly on the screen until it flies out of the screen and disappears. Mango waves his right hand and says): Bye.*
> *B：原来毛毛虫化茧成蝶飞走了 [It turned out that the caterpillar turned into a butterfly and flew away]。*
> *Z: What's up?*
> *(Background music comes with a yellow star animation in the middle of the screen.)*
> *Z (Mango clicks at the star on the screen and says): Star! (He watches the star animation after clicking, then looks at his mother and says) Fifty-nine stars! Oh my god.*
> *(Quote 4.2.20)*

Like quote 4.2.18, in the above example, Mango formed interactions with this touchscreen app independently (Bronfenbrenner & Morris, 2006). During this process, his agency in practising languages and developing his digital literacy skills was highlighted with the help of responsive touchscreens (Kucirkova, 2019; Peebles et al., 2018). For example, although the background voice and the screen animations were in Chinese (see the underline), Mango only responded in English while he positively engaged and responded to the app content (see the double underlines).

Meanwhile, in this example, many interactions between Mango and the multimodal effects in the app could be seen. Some touchscreen apps could provide entertainment and responses for children at the same time (Farrugia & Busuttil, 2021). For instance, when Mango clicked at the screen and saw the butterfly animation, he got excited and watched the butterfly animation carefully; he waved and said goodbye to the butterfly

when it flew away.

The child's motivation to use this app increased because the multimodal effects encouraged him to continue to play. In this example, when the yellow star appeared as a reward that indicated him moving to the next level, he clicked at the star and said excitedly that he got fifty-nine stars in total. Besides, when I asked Mango if he liked playing this app, he nodded, said yes, and told me that he had learnt to write twenty Chinese characters from this app. In the third interview, Mango voluntarily explained to me about one character that he learnt in the app; he wrote the character in the air with his fingers, *"那个'山'就很像一个'ding ding ding'，是一个这样这样，两个小的 [That '山 (i.e., character of mountain in Chinese)' is like a 'ding ding ding', it's like this this, two small ones]。(Quote 4.2.21)"* The sound 'ding ding ding' he said matched with the sound effects in the app when he practised writing Chinese characters in correct stroke orders. This example clearly showed that Mango remembered how he learnt to write this character within this app with a specific sound effect.

The above examples of Mango's engagement with *iHuman Chinese* demonstrated how Mango developed his Chinese character writing skills while using this app. In other words, Mango's digital literacy (Marsh, 2019) is facilitated while engaging with this well-designed app. With the help of multiple modes such as sound and image effects (Jewitt & Kress, 2003), children could develop their digital literacy through multimodal meaning-making progress through well-designed apps and touchscreen devices (Erstad & Gillen, 2019; Mifsud et al., 2021).

As an educational app that targets at helping children learn and write Chinese characters, *iHuman Chinese* was designed to balance the educational and entertaining contents, which gave Mango the opportunity to learn and play at the same time. As his mother said, *"我觉得这个是真的有用的，因为它特别适合小龄，因为它很多都是游戏 [I think this (i.e., iHuman Chinese) is really useful, because it is especially suitable for young age (children), because most of (the contents in) it are games]。如果你要是小孩喜欢游戏的话，它这个对他算是一个吸引力，有个兴趣 [If your child likes games, this is an attraction and interest to him]。(Quote 4.2.22)"* As the mother said that this app was entertaining and educational at the same time, for apps with clear language learning goals, it can be 'edutainment' (Little, 2019).

Meanwhile, as a well-designed app targeted for children, it limited the screentime of children. As the mother said, *"洪恩识字它有一个时间限制是二十分钟。就是二十分钟之后你也不能玩了，它就直接关掉了 [iHuman Chinese, it has a time limit of twenty minutes. After twenty minutes, you cannot play anymore; it will just switch off]。(Quote 4.2.23)"* According to the mother, this in-app time restriction was helpful because she did not need to sit there and supervise Mango's touchscreen use. Mango's mother applied distant mediation (Zaman et al., 2016) since she let Mango play the app independently while supervising his touchscreen use with the help of in-app timer.

Considering all the beneficial features of this app, although this app needed a purchase and subscription, the mother said that she was willing to subscribe to it every month.

> *"我觉得如果每个月三镑钱它可以达到一个很好的效果，而且没有什么各种奇奇怪怪的广告 [I think if three pounds a month it can achieve a good result, and there*

is no that kinds of strange ads]。……他可以安静的坐在那里，然后又学到了东西，我觉得这个钱，我还是一个月几镑钱可能还是愿意花的 [He can sit there quietly and learn something. I think money for this, I would like to spend a few pounds a month]。" (Quote 4.2.24)

For the mother, she believed that there was a careful selection of contents and mediation methods within this well-designed app, which also helped Mango learn Chinese characters in a practical and entertaining way.

Moreover, as the examples above illustrated, intensive interactions between the touchscreen and Mango could be seen, but limited parent-child interactions appeared during Mango's engagement with this app. Parent-child interactions in other touchscreen times of Mango were also rare. His mother explained about this in the second interview. *"如果我都给了手机了，我就希望我能安静一会 [If I already give (him) my phone, I would hope to have some quiet moment myself]。(Quote 4.2.25)"* Although she mentioned that she would keep an eye on Mango as a way of mediation, she preferred to have some individual time when Mango was using touchscreens. The lack of parent-child interaction in Mango's case was not unusual. A few parents use digital devices to distract their children from parent-involved activities so they can concentrate on their own tasks or leisure time (Hiniker et al., 2018).

As some scholars argued, parent-child interaction and parental support during the co-use of some educational apps might help their children develop their language and the related topics in the apps (Sheehan et al., 2019). If the parents focus on their own screen time, form less communication, or give less attention to their child, possible negative effects on the child's varied developments may show (Kildare & Middlemiss, 2017). It is worth considering whether the support and interactions within the well-designed apps are sufficient and can replace the role of parent-child interactions during touchscreen activities.

To make it clear, the less intensive parent-child interactions during Mango's home screen time were not a mirror of all his family activities. As the mother said in the second interview, *"如果是想要跟他做东西的话，我不会在手机上做，我会拿一个书或者纸，就是真的好好坐下来做的东西 [If (I) want to do something with him, I would not do (it) with the phone, I would fetch a book or paper, (we) sit down and do the things properly]。(Quote 4.2.26)"*

Research found that some parents may choose to spend family time together with their children doing physical activity instead of digital activities (Sebire et al., 2011). In Mango's case, home touchscreen time only formed a small bit of his family life; he liked to do sports outdoors and play Lego indoors most of the time. The parents preferred to communicate more with Mango during his other family activities than during touchscreen time.

4.2.4 Summary

To summarise, Mango was a trilingual child who also spoke some French at school, and he could distinguish all three languages. While French was a less frequently used language that he only spoke to his teacher from time to time, Chinese and English were the two languages that he spoke at home in his daily life. Translanguaging

between Chinese and English was one common feature of Mango's language use, which was related to his parental language habits and previous FLP.

The FLP in Mango's case changed; the parents wanted to change their FLP because of the pressure of Mango's school entry exams. The parents intended to speak more English with Mango and explain things related to his study in complete English. Mango's language choice during his touchscreen time and family life was influenced by both parental decisions and his own language preferences. Mango was clear about his trilingual language identity and felt positive about developing his heritage language, Chinese. He played an active role in influencing his FLP. He set Chinese-only rules with his parents sometimes, even though he faced the pressure to improve his English skills for better school performance.

Besides, Mango's home touchscreen use changed in a variety of ways. First, his touchscreen activities increased chronologically throughout the data collection. Some changes in his touchscreen use were because his interests in using certain apps came and went; other changes could be more related to parental mediation strategies. From the above analysis, restrictive parental mediation, such as setting rules and limiting Mango's touchscreen time, was one significant feature. Meanwhile, Mango's own will also influenced his use of apps; his will was respected in a way while balancing parental attitudes and mediations towards his touchscreen adoption. Then, his touchscreen devices also changed greatly, from his mother's mobile phone to an iPad and his own touchscreen watch.

The language exposure during his touchscreen activities changed slightly. Mango's digital literacy during his touchscreen activities developed gradually. The use of oral English and Chinese was common; written English appeared in several activities; and written Chinese was added in only one activity by the time of the third mediagram. Looking into the examples of Mango's touchscreen use, English was the most frequently spoken language that Mango used during these activities. Besides, while Mango practised his languages through the engagement with interactive touchscreen and app designs, few parent-child interactions appeared in his touchscreen use throughout the data collection period. His touchscreen time was rather limited, and the parents preferred to engage more with him during other non-digital family activities.

4.3 Moe's case study

4.3.1 Introducing Moe's case

Moe was a three-year-old girl who lived in middle England with her parents and her little sister, who was one year old. Her mother was Chinese, and her father was English. Moe was born and raised in England, and she was exposed to both Chinese and English in her daily life. Moe did not start going to nursery during the data collection period. The family was recruited through a social media platform. The mother and I made a phone call to discuss the details of the study, the information letter was sent to the parents, and parental consent was obtained before conducting the research. Moe's assent was gained every time before and during the interviews.

Three interviews were held with the family (around 2.5 hours in total). The first two interviews were conducted with the whole family; the third one was conducted with Moe, her mother, and her little sister. The intervals between each interview were around one month. As her little sister was too young to engage in the interviews orally, the father needed to look after the little one during the interview from time to time, most of the interviews were held with Moe and her mother. One language portrait (LP) activity was conducted between Moe and her mother before the first interview because

her mother was worried that Moe could be too shy to finish the activity with my presence. And a video of this LP activity was recorded by the mother and sent to me before the first interview. We had a follow-up conversation about this activity at the beginning of the first interview (more details about this will be discussed in 4.3.2.1). Four parent-recorded videos were sent to me between interviews (two videos each time, about 4 minutes in total). Three adapted mediagrams were drawn and amended after having each interview and discussing the contents of the mediagrams with the family.

4.3.2 Moe's language choice

As a bilingual child, Moe was exposed to both Chinese and English in her daily life. However, her language capacity in Chinese and English showed a clear difference in several aspects. The details of Moe's language choice will be discussed with her LP activity, other data collected through the family interviews, and the parent-recorded videos below.

4.3.2.1 Language portrait (LP)

Before conducting the first family interview, Moe's mother and Moe did the language portrait activity together without my presence. Moe's mother introduced this activity to Moe as we discussed through a previous phone call, and she recorded the whole process of this activity and sent it to me before the first interview. From the conversation between Moe and her mother during this activity, as a three-year-old, Moe seemed not to be able to distinguish the two languages by the two terms, English and Chinese. She did not give responses or start painting, and she seemed a bit confused when her mother said the two terms. But she seemed to understand more when her mother said the vocabulary of one body part in both English and Chinese. Just as the following conversation illustrates:

M (Moe's mother): What is this part? Is it 'hair'? Can you say 'hair'? Say '头发 [hair]' ?

S (Moe): (Moe draws the hair part of the body silhouette in orange a bit where her mother just pointed and says): Hair.
M: Yeah, hair. Oh, you can say hair, then do it by blue because blue is English.
(Her mother painted part of the hair in blue for her, then Moe changes the pens from orange to blue and draws the hair in blue together with her mother.)
……
M: What is this? Is this hand? Leg? Feet?
(Moe does not reply but keeps drawing with the orange pen wherever her mother points at.)

M: Can you say, 脚 [feet] ? say 腿 [leg] ? can you say 手 [hand] ?

S (Moe listens and then stops drawing in orange.): Ok, can I have blue? Blue.
(Moe smiles.)
……
M: Where her, where her legs?
(Moe draws on the legs in blue.)

M: Oh yeah, legs. Can you say 腿 [Leg] ? 腿 [Leg] ?

(Moe smiles and shakes her head.)
M: No. Then you can, come on, draw blue.
(Quote 4.3.1)

From the extract of the LP conversation, Moe's mother tried to connect the colours with the vocabularies in the two languages, for example, *'hair'* and *'头发 (i.e., the word for*

hair in Chinese)'. If Moe could say *'hair'* but not *'头发'*, they painted the hair part of the body silhouette in blue, which represented English. When they moved to talking about the hand, leg, and feet, Moe first drew these parts in orange while her mother was saying these words in English. However, after her mother asked her if she could speak these words in Chinese, she stopped drawing with the orange pen, and she told her mother she wanted the blue pen. Similarly, when her mother asked if she could speak *'leg'* in Chinese, she shook her head. These actions of Moe may suggest that she was aware of the vocabularies that she could or could not speak, but this did not necessarily mean that she could distinguish the two languages. It should be noted that Moe's mother helped her write down the colours that represented languages in the left column of her LP painting; her mother accidentally wrote 'orange' instead of 'Chinese'. But she did explain clearly to Moe that the orange colour represented Chinese while doing this activity.

When we discussed the LP painting in the follow-up conversation in the first interview, Moe could not explain why she chose the two colours and why painted that way. Just as the conversation below illustrates:

R: Can you tell me a little bit more about your painting? Can you show it to me?
(Moe smiles and looks at her painting.)
M: Why you paint it blue?
S: It's blue.
M: Why is it blue? Why is that orange?
(Moe looks at the painting and shakes her head.)
(Quote 4.3.2)

From the conversation, Moe shook her head and did not answer the questions about why she painted with the two specific colours. The LP activity is argued to be useful for the researchers to learn more about the children's language understanding (Soares et al., 2020). In my study, the LP activity was designed as an ice-breaking activity to help children visualise their understanding of their linguistic repertoires. Research suggests that the exercise-based LP activity evokes more interest and less stress for the children, compared to holding traditional interviews (Tatham-Fashanu, 2021). For Moe, the LP instructions seemed not easy to understand or follow, although she showed interest in participating in this activity. Rather than demonstrating her linguistic repertoire, Moe's LP activity was more like a collaboration between her and her mother to illustrate the vocabularies that she mastered in the two languages.

Image 11 Moe's language portrait

4.3.2.2 Family language policy (FLP)

Throughout all the data collected, the dominant language used in Moe's daily life was English, and Chinese was used in her daily life but not intensively. Their family language policy (FLP) (Wilson, 2020) came from the actual situation of the language environment in the family. As the mother said in the first interview:

> *"D(Moe's father) 是在学中文，但是绝大部分我跟 D 的沟通都是英文 [D is learning Chinese, but most of the communication between me and D is in English]。而且*

D 跟她的沟通也是英文，就只有我跟她的沟通是中文 [D communicates with her (Moe) in English, only me communicate with her in Chinese]。所以英文会占三分之二，然后我的部分会占的少一点 [So English would account for two-thirds, then my part (Chinese) could account for a little less]。所以她的英文还是主导 [So her English is still (the) dominant (language)]。(Quote 4.3.3)"

As Moe's father was English-monolingual, although the mother said that he tried to learn Chinese, the communication between the parents and Moe was mainly in English. Moe's mother was the main person who spoke Chinese with her, but she did not always speak Chinese with her either. A certain level of HL loss or language shift (Fishman, 2001) was found in Moe's home language practice. Moe's mother spoke English with Moe most of the time and only some simple Chinese words or sentences during her daily life. This finding matched another study conducted with Chinese heritage interlingual families in Australia (Huang & Liao, 2024), in which a Chinese mother reported that they only spoke English with children when the English father was at home. FLP in interlingual families can be adjusted to meet communication needs and maintain a harmonious family relationship (Huang & Liao, 2024). Throughout the data collection, Moe's FLP was rather fixed and did not change much. As for the language use of Moe, she spoke fluent English but rarely spoke Chinese during the whole data collection period, except singing a Chinese song with her mother during the second interview.

Besides, imitating parental behaviours was one vital way for a child to develop in the early stages (Bandura, 1977). For Moe, listening and imitating her parents' language use was a main method for her to develop her oral language skills in both languages. Just as Moe's mother said in the second interview when reflecting on Moe's language use:

"她说的东西越来越多了，而且她 copy 我们两个，copy 的很快 [She speaks more and more things, and she copies us (i.e., the way the parents speak), (she) copies very quickly]。就我们说一个什么东西，她听一遍她就会重复出来 [It's just when we say something, she listens once and she could repeat (it)]。(Quote 4.3.4)"

She explained in more detail about this feature of Moe's language practice in the third interview:

"即使你没有跟她刻意说的，她有时候听到我跟 D 说话，她也会学 [Although you did not speak to her deliberately, sometimes when she heard me speaking to D, she also learnt (to speak)]。现在我们已经要很注意了，不能当着她的面说脏话，然后语言要规范一点，不然她都会学会 [Now we already need to be very careful, not to swear in front of her, and the language needs to be more standardised, otherwise she would learn it]。(Quote 4.3.5)"

As Moe's mother said, Moe developed her oral language skills through listening and repeating what her parents said in an effective and frequent way. The parents were very cautious about their language use with Moe. A related example in practising oal Chinese was also given by the mother in the third interview,: *"每次一到广告，我就跟她说，我说 Moe 等一下，这个是'广告' [Every time it is ad time, I would tell her, I say Moe, wait a moment, this is 'guanggao (i.e., the Chinese pronunciation for ad)']。我还*

用中文跟她说 [I say to her in Chinese]。然后她有时候，特别在电视上一看到广告跳出来，她自己就说'广告广告' [Then sometimes when she, especially when she sees the ads pop out on the television, she would say herself, 'guanggao, guanggao']。(Quote 4.3.6)"

Moe mastered both the pronunciation and the meaning of the Chinese word *'广告 [ad]'* after her mother said the word to her in Chinese when the ad pops out. This example indicated the importance of her parents' oral input in her early language development.

Since parental language use played a vital role in Moe's early language acquisition, their FLP with different amounts of oral inputs in English and Chinese leads to the different bilingual language developmental stages of Moe. For example, when reflecting on Moe's bilingual language capacities in the third interview, the following conversation took place.

M: 中文她现在会多说一个妹妹 [(In) Chinese, she now can say one more (word), sister]。然后会唱《两只老虎》 [Then (she) can sing 'Two Tigers']。还会说一二三四五，但是只能数到五 [(She) can also say one, two, three, four, five, but only count to five (in Chinese)]。

R (Researcher): Ok. 那她英文呢 [How about her English]？数数，能数到几呢 [Counting, which number can (she) count to]？

M: 能数到二十 [(She) can count up to twenty]。

R: 好厉害 [Impressive]。

M: 然后英文会唱好多儿歌 [And (in) English (she) can sing many children's songs]。那个《小星星》 [That 'Twinkle Star'], 'Twinkle Star'，然后还有那个 [and then that one]，就那个 'head shoulder knees and toes' 的那个歌 [that 'head shoulder knees and toe' song]。然后也会跟着跳 [And (she) can dance with (the songs) as well]。然后还有 'Baby Shark' [And then 'Baby Shark']。

(Quote 4.3.7)

From the conversation, Moe's vocabulary in counting numbers and mastering children's songs in English and Chinese varied; her English vocabulary and language acquisition developed better than her Chinese in that stage. Moe's different bilingual language capacities indicated HL loss to a certain level. The HL loss can be found in many cases with children from immigrant family backgrounds; providing sufficient HL learning support to their children can be challenging for many parents (Park et al., 2012). More about this will be discussed in section 4.3.3.

Moe's bilingual development was also primarily related to proximal processes in her immediate environment, which are parent-child interactions in the daily home environment (Bronfenbrenner & Morris, 2006). The characteristics of parents significantly influenced Moe's English and Chinese development outcomes. For example, as Moe's father could only speak English (resources), Moe's mother chose to speak mostly English during family communication and sometimes Chinese to Moe (forces and resources). During these kinds of proximal processes, Moe practised more English compared to Chinese.

4.3.3 Evolving mediagrams

When looking into Moe's language use through the lens of her touchscreen activities, more language use patterns other than listening and imitating the parents' language use were found. The main touchscreen device Moe used throughout the data collection was her iPad. More about it will be discussed below with the evolving mediagrams and other collected data.

4.3.3.1 Moe's first mediagram

The first mediagram was created after having the first interview with Moe's family; the names of the apps that Moe used were sent to me shortly after this interview. As a three-year-old Chinese-English bilingual child, Moe's home touchscreen activities were various. Looking into the first mediagram, Moe engaged with plenty of apps and formed different types of touchscreen activities, such as playing games, watching cartoons and videos, taking and checking photos, and video-timing with her grandmother who lived in China.

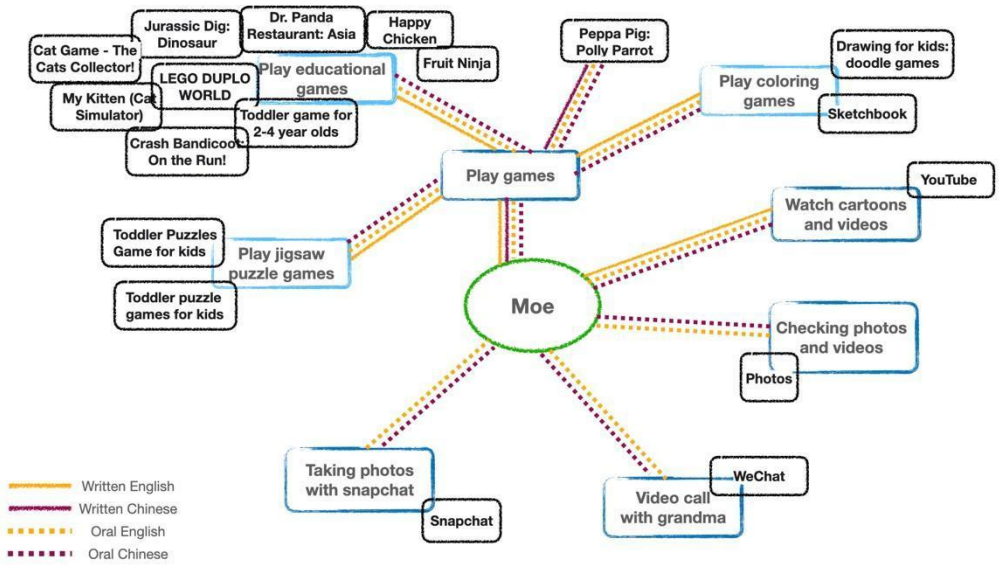

Image 12 Moe's first mediagram

One reason behind Moe's rich touchscreen activity was because Moe's parents were positive and open to her touchscreen adoption (Chaudron et al., 2019). The mother expressed her attitudes in the first interview:

> *"我跟 D 就觉得就是现在时代在进步，电子产品越来越多，就是已经不可能把电子产品剔除出小孩的生活里了 [D (Moe's father) and I feel that now with the progress of the times, there are more and more electronic products, it is impossible to eliminate electronic products from children's lives]。所以只要她是能，就是把它用在好的地方，是在锻炼她的大脑发育的就可以 [So as long as she can, use them in a good way, and it is for her brain development, it's fine]。(Quote 4.3.8)"*

As digital technology is frequently embedded in children's family life, many studies have identified a significant increase in children's adoption of touchscreen devices (Harrison & McTavish, 2018; Kumpulainen & Gillen, 2019; Marsh et al., 2018). As Moe's mother said, they believed that using digital technology was part of the child's daily life and it was unavoidable, and they felt positive about the potential benefits of

these new technologies on Moe's cognitive development.

As the first mediagram shows, the positive parental attitudes towards touchscreens lead to plenty of touchscreen activities (Chaudron et al., 2019). However, being open to digital activities did not mean no parental mediation (PM) (Zaman et al., 2016) on Moe's touchscreen use. For example, as the mother said in the first interview,

> *"就是如果她看动画片的时间太长了的话，我们会有意识地把那个 iPad 关掉，然后陪她一起在这玩她的那些玩具什么的 [If she watches the cartoons for a very long time, we will switch the iPad off consciously, and then (we) accompany her to play with her toys and stuff like that]。但是如果她是玩那些益智游戏的话，一般都不是很限制她 [But if she plays those educational games, we normally will not limit her (use)]。(Quote 4.3.9)"*

Moe's parents separated her touchscreen activities as sedentary screen-viewing (i.e., watching cartoons) and other educational activities. They set different parental mediation (PM) strategies towards these two types of touchscreen use. The mother did not mention their PM strategies from the language use perspective, but only stressed on the strategies related to Moe's touchscreen activity types.

Different from other touchscreen activities, watching cartoons and videos involves fewer active interactions between the child and the screen, and the child may have more passive screen-viewing time. Research has addressed the potential negative effects of sedentary screen-viewings for children, such as obesity risks (Zhu et al., 2019), and associated physical activity with more positive effects on children's health (Jago et al., 2010). Some parents may prefer engaging with their children in physical activity to substitute and decrease their children's screen-viewing activity (Sebire et al., 2011). Similarly, in Moe's case, the parents use restrictive mediation (Zaman et al., 2016) on her sedentary screen-viewing activity. And they preferred to accompany Moe doing some activities with her toys rather than the screen-viewing activity.

Besides, the parents also monitored and selected the contents of Moe's screen time. For example, the app in Moe's touchscreen cartoon time was changed from *YouTube* to *YouTube Kids*, by the time of the third interview. Because the mother found that:

> *"用 YouTube 有时候她打开的那个视频就不太适合她看 [When using YouTube, she sometimes opens a video that is not proper for her to watch]。……现在小孩的那个频道有时候会推点奇奇怪怪，有点像鬼畜一样的东西，就是那种视频 [Now the child's channels sometimes recommend strange things, kind of like kichiku stuff (i.e. auto-tune remix-themed content), that kind of videos]。然后就又给她下了一个 YouTube kids，就小朋友的那个 [Then (I) downloaded the YouTube Kids for her, the one that suits for children]。(Quote 4.3.10)"*

However, when discussing the other touchscreen activities, active mediation and co-use (Zaman et al., 2016) were the two types of PM strategies frequently found in Moe's case. As the mother said in the first interview,

> *"她玩 iPad 基本百分之八十都是她自己一个人玩 [Basically eighty percent of the time she plays iPad herself independently]。就是她自己坐在角落里玩，但是有的时候她会让我们陪着她玩 [It's just she sits in the corner to play, but sometimes she*

would let us accompany her to play]。或者是有的地方，比如那个拼图她拼不对了，她就会叫你过来帮她 [Or sometimes when, for example, she could not put the puzzle correctly, she would ask you to come and help her]。(Quote 4.3.11)"

As the mother stated above, in Moe's touchscreen time, children's agency (Schlosser, 2015) was highly respected. The parents could come to help and accompany Moe's touchscreen use when she asked for it. However, the freedom to play touchscreen and choose apps independently did not mean that Moe's touchscreen activity was unsupported. The parents offered support when she felt it was difficult to play independently. This kind of parental support was based on the child's needs, and it was not an action of co-play for fun during the child's touchscreen use.

The scaffolding in children's co-use activity may contain many techniques, such as verbal and operational support (Wood et al., 2016). Similar patterns of parental scaffolding were found in Moe's case. For example, the following conversation happened when we discussed Moe's favourite app in the first interview:

R: Can you show me your favourite app on iPad?
M: Which one is your favourite? Which one? This one?
S (Moe browses the iPad screen and points at one app symbol): This one.
M: This one, you want to play this one?
S (Moe nods): It is pink, aren't it?
M:这个是跑酷，有点像那个古庙逃亡 [This is a parkour (game), kind of like Temple Run]。……这个游戏是她想玩的，然后给她下了之后发现她不会 [This was a game that she wanted to play, and (we) downloaded it for her but found that she could not play]。因为有点难，对她这个年龄 [Because (it is) a bit hard, for her age]。然后我就会帮她玩 [Then I would help her to play]。然后她发现我能帮她玩过关之后，就总是把这个游戏拿过来让我玩 [Then she found that I could help her pass the levels, so she often brings the game to me and lets me play]。然后我帮她玩，她看我跑的很好的时候，她就又把它抢过去，她自己玩的话她就 '死' [Then I help her play; when she sees that I am doing well, she then snatches it away and she will lose the game if she play it herself]。然后她就再把它给我，让我开始 [Then she gives it to me again, and let me begin (to play again)] (Quote 4.3.12)。

The above conversation explained a scenario when Moe wanted her mother's assistance when playing a touchscreen gaming app. The app Moe liked was called *Crash Bandicoot: On the Run,* which was not a game designed for early childhood users. While admitting the game was difficult for Moe to play at a young age, her mother downloaded this app, considering more of Moe's interest than the target age group of the app. This example indicated active mediation by Moe's mother. She respected Moe's interests on apps and improved Moe's touchscreen gaming experience by helping her operate it when she asked.

When talking about the language use during the parent-child interaction and co-play activity in the first interview, the mother said that *"她应该一直都是说英语吧 [She (Moe) should be speaking English all the time]。她其实也不说什么，她就是直接把它递到我手里然后喊 'mummy'，然后让我点它的屏幕，我就知道她是什么意思了 [She actually does not say much, she would just hand it (the iPad) over to me and say 'mummy',*

then let me press the screen, I know what she means]。(Quote 4.3.13)"

As the mother's narration showed, not much parent-child interaction appeared, and Moe only spoke simple English words during their co-play activity. Moe spent most of the time observing her mother's operation and tried to play herself when she felt confident. As some studies indicate more parent-child interactions are found in some co-use touchscreen activities (Neumann, 2016; Skaug et al., 2018), other studies suggest a lack of parent-child communications during family touchscreen use (Hiniker et al., 2018; Kildare & Middlemiss, 2017). In Moe's case, her touchscreen use was independent most of the time, except sometimes she needed parental scaffolding or assistance.

Meanwhile, different amounts of parent-child interactions were found when she had different needs during her screen time. For instance, although few parent-child interactions appeared when Moe asked for her mother's help to play *Crash Bandicoot: On the Run*, more parent-child communication was found when Moe asked her mother to accompany her to play the app *Drawing for kids: doodle games* (see details in 4.3.3.2).

Besides, when reflecting more on her own language use during Moe's touchscreen time, the mother said in the first interview that when she accompanied Moe playing touchscreen games, *"应该是两种语言在一起 [(I) should be (speaking) both languages]。(Quote 4.3.14)"* Therefore, both oral Chinese and oral English were demonstrated in Moe's touchscreen activities within the first mediagram. However, the portions of Chinese and English used during touchscreen use may not be equal. In all the parent-recorded videos that the mother sent me, she spoke English most of the time with Moe in these videos and rarely spoke Chinese. More specific examples from these videos will be demonstrated in 4.3.3.2.

Moreover, the mother reported another feature of Moe's language choices of her touchscreen apps in the first interview:

> *"大部分游戏都还是英文 [Most of the games are in English]。因为我们在这边下的游戏,就是它用的都是英文 [Because we download the games here (i.e., in the UK app store), and they are all in English]。(Quote 4.3.15)"*

As the first mediagram demonstrated, the mother said that only one app called *Peppa Pig: Polly Parrot* was downloaded in Chinese, because *"那个有中文的我就会切到中文，我切到中文她也会玩 [That (app) has the Chinese (version in app) so I would switch to the Chinese (version); she can also play (the game) when I switch to the into Chinese] 。(Quote 4.3.16)"*

Within the UK app store, most of the apps downloaded are in the English setting. Finding and navigating appropriate HL apps in the app store for their children could be challenging for some parents (Little, 2019). As the above example indicated, Moe's mother would switch the apps into Chinese versions if she found them available. However, only limited written Chinese exposure can be found in this app, except when Moe passed a level and simple Chinese words would appear on the screen (as the following image shows).

Image 13 The written Chinese shown in app Peppa Pig: Polly Parrot

However, although the mother said the app resources that they could download were mostly in English, it was worth discussing if this understanding came from a common sense or an objective fact. When I searched some apps mentioned in the mediagrams, many of them had multiple language choices. For example, for one app that Moe liked to play and is discussed further in 4.3.4.2, *Lego Duplo World*, the information page of this app showed that this app has 24 language options, including the simplified Chinese version. After downloading this app, I examined the app settings; there were no options to switch languages within this app. But when I set my priority system language of this app as Chinese in my iPad settings when clicking the name of the app, the inner language of this app changed to Chinese when I opened it again. For touchscreen devices purchased in England, the priority language setting of the device may be commonly in English, so the apps they downloaded were mostly the English versions initially. I tested a few apps that Moe used by changing the language from English to Chinese in the 'referred language' column when clicking on the name of each app that can be found in the iPad *Settings*, and the in-app language setting was immediately changed to any available language options of this app.

For Moe's mother, she may lack awareness that the apps were available in several languages or technical skills to switch languages for Moe, excluding some apps that she found options to switch languages inside the downloaded app (e.g., the *Peppa Pig: Polly Parrot app*). Therefore, although some apps in the app store do offer multiple language options, parents or children may lack the digital operational skills or technological understandings (Little, 2019) to set the app languages into their HL.

4.3.3.2 Moe's second mediagram

The second mediagram was amended with the family during the second interview after discussing the first set of parent-recorded videos. Compared to the first mediagram, after one month, the types of Moe's touchscreen activities and the language use did not change much in the second mediagram. However, for the activity of playing educational games, new apps were added while some old apps were no longer used. As the mother said in the second interview, *"她就是不停地，不停地让我们下新游戏 [She just constantly, constantly asks us to download new games]。(Quote 4.3.17)"*

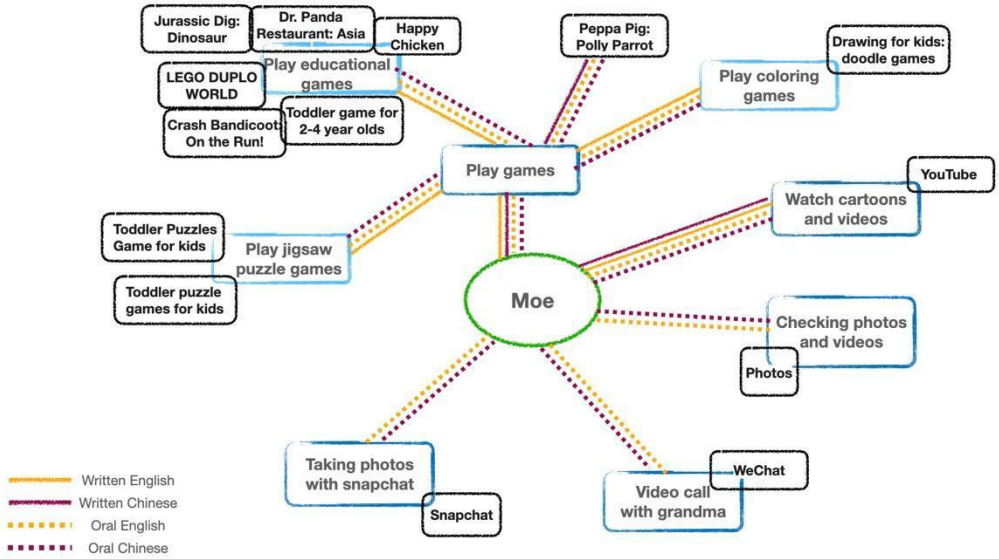

Image 14 Moe's second mediagram

Moe's interests in touchscreen games changed quickly, and she asked her parents to support her touchscreen use. For example, when her father asked about her favourite app in the second interview, the following conversation took place:

D (Moe's father): Moe, come on, which one?
M (Moe's little sister climbs on the table): Olivia (i.e., Moe's little sister's pseudonym) ……
D: She is thinking.
M: She's thinking. Pick one.
D: Pick one.
(Moe opened the Lego Duplo World app.)
M: Oh, this one.
(Quote 4.3.18)

Moe's new favourite app, *Lego Duplo World,* was designed for 2–5-year-olds and involved many in-app purchases to unlock additional contents. As the mother said in the second interview, *"然后乐高里面有，你知道里面有不同的主题吗 [Then in the Lego game, do you know there are different themes in it]？有不同的主题是需要你花钱去解锁的，她就不停让我给她买新的 [(The app) has different themes that you need to pay and unlock them, so she constantly asked me to buy new (themes) for her]。(Quote 4.3.19)"*

Moe's mother shared more about her experience of the in-app purchases for Moe in the third interview:

"她有好多游戏都是每个月四五镑，每个月四五镑 [She has many games (that cost) four or five pounds every month]。我觉得就这个游戏订阅，每个月我估计得给她定了三四个了 [I think for the game subscription, I may have ordered three or four (subscriptions) every month]。等她什么时候不玩了我就取消一个，不玩了就取消一个 [I would wait until she does not play a game, and I cancel that one, when she does not play (one app), I would cancel (that) one]。(Quote 4.3.20)"

As gatekeepers, parents offer their children access to touchscreen devices and apps through checking and purchasing apps (Little, 2019). In Moe's case, since the parents were open and positive for most of her touchscreen use, they were willing to subscribe to the games for Moe and financially able to do so. They fully respected her interests in playing these apps and supported her touchscreen activities with in-app purchases when needed. Besides, with parental support and active mediation, Moe's will and preferences during her touchscreen activities were largely respected. For example, Moe would install the games herself when her parents opened the App Store for her. As the father said in the second interview, *"She finished installing, like, six games. (Quote 4.3.21)"* She also deleted the games that she no longer liked to play; for example, she deleted the app *Happy Chicken* while having the second interview.

In terms of the parent-child interactions, as discussed in the first interview, Moe sometimes asked her parents to accompany her during her touchscreen use. Different from the co-use activity of *Crash Bandicoot: On the Run*, more intensive parent-child interaction was found in other co-use touchscreen activities. The clip in the parent-recorded video 2 illustrates the parent-child interaction in one of Moe's touchscreen activities with her mother:

> *(Moe is playing an app called Drawing for kids: doodle games*. She *touches the screen and opens a blank picture of a lion.)*
> *M: Ok, what colour do you want (to paint) the lion?*
> *(Moe clicks the green button of a check box on the right column of the screen, and the interface changes to the catalogue version again. Then Moe touches the screen and opens the same picture of a lion again.)*
> *S: It calls, it calls 'lion'. (Moe points at the symbol of a pen on the right column of the screen.) This call 'yellow'.*
> *M: You want a yellow lion?*
> *S: Yeah, yellow? Yeah.*
> *M: (Moe's mother touches the pen symbol and helps her to open the options of changing colours.) Choose.*
> *S: (Moe clicks the pen symbol again and opens the options herself.) Yellow.*
> *M: (Moe's mother pointed at the symbol for choosing colours; Moe and her mother clicked this symbol together.)*
> *S: Yellow.*
> *(Quote 4.3.22)*

In this example, Moe and her mother negotiated about how to paint a lion. Except for supporting Moe find the place to choose colours, the mother did not touch the screen and let Moe operate the game (see image 15 below). As the above underlined sentences indicated, oral English was used throughout their conversation, and meaningful discussions about choosing colours took place through that co-play activity. Compared to the co-play of the parkour app discussed in the first interview, this co-play painting activity was led by Moe instead of her mother. From the bioecological perspective (Bronfenbrenner & Morris, 2006), Moe used her previous knowledge about colours and the operational skills of this app (resource characteristics of the developing child) to express her creative, linguistic, and cognitive needs during this activity, with some parental scaffolding. With the multimedia effects of iPad apps, both the parents and the children are encouraged to share more thoughts, and children's language development may be positively influenced (Kucirkova et al., 2013) during these interactions in this process (Tong & An, 2024).

In addition, similar to Marsh and her colleague's (2016) study on children's digital play experience, Colvert's (2015) model can also be applied in the meaning-making process of Moe's engagement with this drawing app. As the above example shows,

Moe first chose to play this app in the design stage, then she used this app to colour a yellow lion by negotiating with her mother, which indicates the production stage (Colvert, 2015).

Image 15 Moe playing the Lego Duplo World app with her mother

In the second mediagram, when looking into the change of language use and exposures, one change was in Moe's cartoon-viewing activity. Besides limiting the cartoon time of Moe mentioned in the first interview, the mother also mediated the subtitles of the videos for more Chinese exposure. As she said in the second interview, that *"平常我放的动画片，比如说它有中文字幕，我就是放中文字幕和英文原声 [Normally the cartoons that I play (for Moe), for example if it has Chinese subtitles, I will play (cartoons) with Chinese subtitles and English audio]。(Quote 4.3.23)"*

Therefore, written Chinese was added to the cartoon-viewing activity in the second mediagram. Study indicates that playing audio-visual (AV) content with subtitles in other languages can facilitate children's multiple language acquisitions and nurture their intercultural awareness (Black, 2022). For Moe, her mother was aware of the potential benefits of using Chinese subtitles and implanted them in Moe's daily life to increase her written Chinese exposure.

Moreover, with few PMs on her touchscreen activities (except her cartoon time), Moe had freedom to explore the apps herself. Besides forming parent-child interactions during her touchscreen time, a feature of Moe's language use was that she spoke to herself while engaging with the touchscreen activities. The example extracted from the parent-recorded video 1 indicated that.

(Moe is playing the app Polly Parrot. The app is a game of turning and matching cards. The screen interface is like below.)

Image 16 Moe playing the app Polly Parrot

(Background music.)
……
S (Moe uses her right index finger to turn the fourth card in the second line and the third card in the third line; the patterns of the two cards match and do not turn back.): Oh yeah, oh yeah. Wuhu…
S: Oh yeah. Oh yeah. (Moe uses her right index finger to turn the second card in the second line and the fourth card in the first line, and the patterns of the two cards do not match and the two cards' animations turn back again.) Oh no.
S: Oh yeah. (Moe uses her right index finger to turn the second card in the third line and the second card in the second line, and the two cards have the same patterns and do not turn back.) Oh yeah.
(Quote 4.3.24)

Through independent activities, interactions between the developing person and objects or symbols are also bidirectional (Bronfenbrenner & Morris, 2006). When playing this app herself, Moe said simple words, such as *'Oh no'*, *'Oh yeah'*, constantly while clicking and trying to match the cards. With multimodal features, some touchscreen apps could provide digital play opportunities for children (Marsh, 2016). Children may use touchscreens at home individually and form digital play practices (Marsh et al., 2018). Moe's frequent oral English expressions and her finger

movements indicated her keen engagement with the touchscreen game, in turn, the app also responded to Moe's engagement by turning the cards back or not in a responsive way. In this way, Moe's agency was also enhanced during this touchscreen activity (Peebles et al., 2018). More examples of Moe's digital role-play will be illustrated in 4.3.3.3 with parent-recorded video 4.

4.3.3.3 Moe's third mediagram

The third mediagram was edited according to the discussions in the third interview and the second set of parent-recorded videos. Compared to the second mediagram, several changes were illustrated in the third mediagram. First, similar to the changes in the second mediagram, Moe's interests in playing different educational apps came and went; a new app named *Sago Mini World: Kids Games* was added. Besides, as the mother said, by the time of our third interview, Moe seldom used *Snapchat* to take pictures or check the photo albums, and this activity was removed from the mediagram.

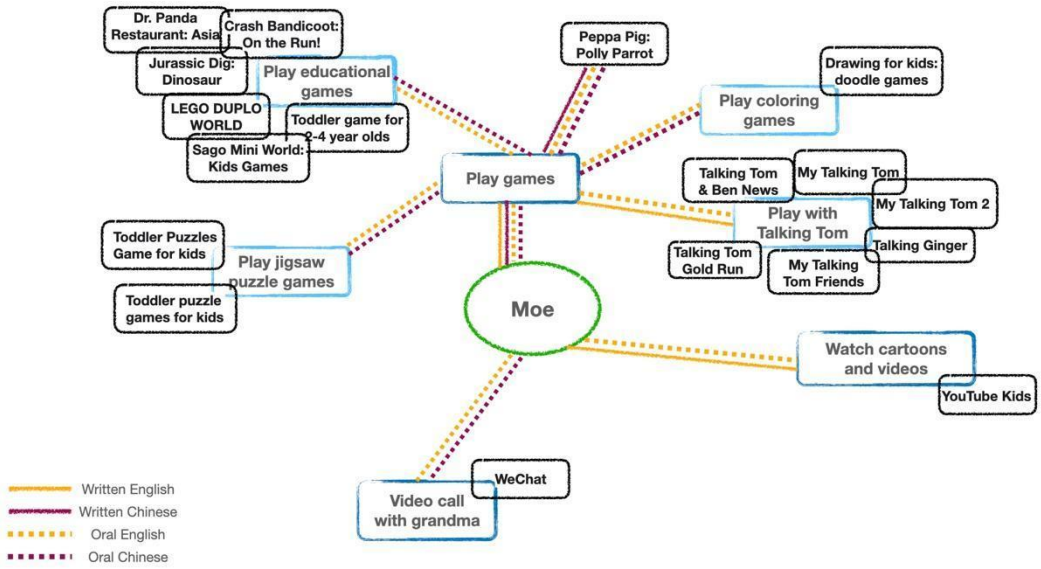

Image 17 Moe's third mediagram

Another activity that Moe was interested in by the time of the third interview was playing a series of *Talking Tom* apps. As her mother commented in the third interview, *"现在她就是喜欢对着那个猫说话，说她自己的名字 [Now she just likes speaking to that cat, say her own name]。她会说 'Moe'，然后那个猫不是会复述 'Moe'嘛 [She would say 'Moe', then the cat would repeat 'Moe'] 。(Quote 4.3.25)"*. Moe knew about this app after one of her parents' friends let her play that game on her phone once, and Moe asked her parents to download it on the iPad for her.

Although the parents respected her interests and downloaded these apps for her, the mother expressed her negative feelings towards the in-app ads of these apps. *"主要是广告太多了，玩着就很费劲 [There are too many ads; it is difficult to play]。……你跟它说话，说不了两句它就应该蹦出来广告了，蹦出来广告就很烦人 [It's just when you speak to it that, within the time of speaking two sentences, some ads would pop out, the pop-out ads are very annoying]。(Quote 4.3.26)"* Too many in-app ads may lead

to negative user experiences and interrupt Moe's oral language practices during this activity.

Although Moe's interests in some of her touchscreen activities changed a lot, she maintained a few touchscreen activities throughout the whole data collection period. For instance, her mother mentioned her interest in using the *Polly Parrot* app in all three interviews, and she kept the habit of video calling her grandmother via *WeChat*. Most of Moe's video time with her grandmother was accompanied by her mother; she was not able to communicate independently with her grandmother due to her limited Chinese language skills. Her mother expressed her expectations for Moe's Chinese development in the third interview, *"希望她先能跟我爸妈交流的程度就可以 [(I) hope that she could first communicate with my parents, and it would be fine]。(Quote 4.3.27)"* For her mother, she set the goal for Moe's Chinese development mainly on her oral language achievement, to fulfil her communication needs with remote family members.

Moreover, as mentioned in the previous discussion, Moe spent plenty of her screen time independently. Besides the oral parent-child interactions during the co-use activities, Moe also spoke English frequently during her own touchscreen time while engaging with certain apps. Similar to the example of the parent-recorded video 1 mentioned in the previous section, another clip extracted from the parent-recorded video 4 illustrated this pattern of Moe's language use more clearly:

(Moe is playing the Sago Mini World: Kids Games app. She moves the cup by using her right-hand index finger to continually press and move on the screen. She moves the cup to a tap water animation and fills the cup with water.)

Image 18 Moe playing Sago Mini World: Kids Games

S: (Moe moves the cup into different scenarios by pressing the screen and moving the cup to the left of the screen and then the right of the screen.) Oh, ok.
S (Then she gives the cup of water to a girl with a bicycle on the screen.) Hmm, do you want a water? Yes! Ok.

Image 19 Moe playing Sago Mini World: Kids Games

(Then Moe continues pressing the screen and holding the cup of water, and she moves back to the first scene. Then she moves back to scene, where the little girl stands near a bicycle.)
S: (She gives the cup of water to the girl again and this time she releases the cup by stopping pressing the screen with her right-hand index finger, and the animation of the little girl gets the cup of water.) Ok!
(Quote 4.3.28)

In this example, Moe was playing the app with animation in different scenarios. She used her finger to touch and trigger some animations, such as the animation of filling up a cup of water from the tap. These actions demonstrated the interactive feature of touchscreens with multimodal animation designs (Dowdall, 2019).

Importantly, as the underlines in the example show, Moe was having imaginary conversations with the animation character in oral English during her engagement with the app. Similar findings were reported by her mother in the third interview:

"她会一直跟那个玩游戏里面的人说话 [She would constantly talk to the characters in the game that she plays]。她会给她们加语言加东西什么的，加戏 [She would make up the oral responses for the characters, adding some drama]。……. 比如说有一个游戏是你可以把，它上面就是一些小人，在不同的场景里，有电影院，有咖啡厅 [For example, there is one game (i.e., Lego Duplo World), it has some (virtual) characters in it, and in different scenarios, such as cinema and cafe]。……然后她玩那个的时候就会，把一个小人摆在凳子上，然后问他 'Do you want water? Yes? Here you go.' [Then when she plays that (game), (she will) put a virtual character on the chair, and ask him, 'Do you want water? Yes? Here you

go.']。就这样，然后再往他手里放一杯水 [Like that, then put a glass of water on his hand]。(Quote 4.3.29)"

Moe loved to play these games with specific real-life situations and did digital role play while using these apps (Fleer, 2017). Digital devices may offer prompts and support for children's imagination of virtual situations or scenarios and form digital role-play (Fleer, 2017). Without the presence of other people, Moe actively interacted with the touchscreen apps through her activities; like the interpersonal interactions, a person's interaction with objects is also bidirectional and facilitates their development (Tong & An, 2024). For Moe, her digital role-play with these responsive apps (Kucirkova, 2019; Peebles et al., 2018) offered her an opportunity to enact her agency and practise her oral English through forming imaginary conversations with the virtual characters. Different from some children's digital role play, such as telling stories to peers or other people while using apps (McGlynn-Stewart et al., 2019), Moe usually formed non-human imaginary conversations with some virtual characters in apps. Besides, her creativity could be promoted through producing original texts when she engaged with multiple apps and digital play (Marsh et al., 2018).

Moreover, when amending the third mediagram together, the mother reflected on the actual written language exposure in most of Moe's apps, she believed that most of Moe's apps contained few written texts. As she said in the third interview:

"游戏里面我感觉 written 的英文也不是很多 [For the games, I feel that there are not much written English]。……就是就那里面的人物说话什么的，好像也不太有字幕，还是听的比较多 [It's just that there may be characters talking (in) there, maybe do not have subtitles very often, most of the contents are for listening]。就声音比较多，文字倒也不是那么多 [There are more sounds, not much written texts]。(Quote 4.3.30)"

Her reflections on this matched what I observed from most of Moe's parent-recorded videos. Moe was frequently exposed to animation and sound effects during her touchscreen use instead of accessing written contents. Therefore, we discussed and decided to delete the solid lines that represented written language in most of the gaming activities in the third mediagram.

The written English was kept for the activity of watching cartoons and playing with *Talking Tom* apps. As the mother specifically pointed out that in *Talking Tom "它会写下面有什么事物，什么就是各种种类的东西你可以喂这个猫吃，或者是你给它穿或者你让它用，下面会有那个小字 [It would show (the names of) things at the bottom, all kinds of things that you can feed the cat, or you can put it on for the cat, or you can let the cat use, small texts appear at the bottom]。(Quote 4.3.31)"*

Similar to the app called *Lego Duplo World* that I examined previously, although the Chinese version of the *Talking Tom* apps was available when I checked the App Store. The mother mentioned they only used the English version of these apps. Although the lack of HL resources is one of the dilemmas that parents may face in providing support for their children's HL maintenance (Park et al., 2012), sometimes the parents may lack digital knowledge or interest to check the languages for each app. The limited HL app adoption may be related to this reason as well.

In the third interview, for the activity of watching cartoons and videos, the mother made it clear that the language used during Moe's cartoon/video time on television and on the touchscreen was different. For Moe's screen time on television, the mother mediated the contents and increased more Chinese exposure, as she said in the third interview, *"我最近开始在电视上放那个迪士尼上面的动画片，我都开始放中文的 audio 跟中文字幕了 [I recently began to play the cartoons (for Moe) from Disney on television, I began to play Chinese audios and Chinese subtitles]。(Quote 4.3.32)"* The main reason behind this parental mediation of Moe's cartoon time was that the mother wanted to create better Chinese environment for Moe, as she expressed in the third interview, *"还是就想尽量让她多听点中文吧 [(I) just want to try my best to let her listen to more Chinese]。(Quote 4.3.33)"*

Apart from that, Moe's touchscreen cartoon-viewing was driven by her own will, and she preferred to choose videos herself. Her mother said in the third interview that "*可触屏一般都是她自己选的，她自己选的一般都是英文的，或者就是没什么话的那种动画片 [(When using) touchscreen, she usually chooses (contents) herself; she usually chooses for (cartoons) in English, or those cartoons without much dialogues inside]。(Quote 4.3.34)*"

Similar findings were found in the parent-recorded video 3 as follows:

(Moe is choosing the video she wants to watch on YouTube Kids.)
(Moe uses her left-hand index finger to choose another Peppa Pig video on the left side of the screen.)

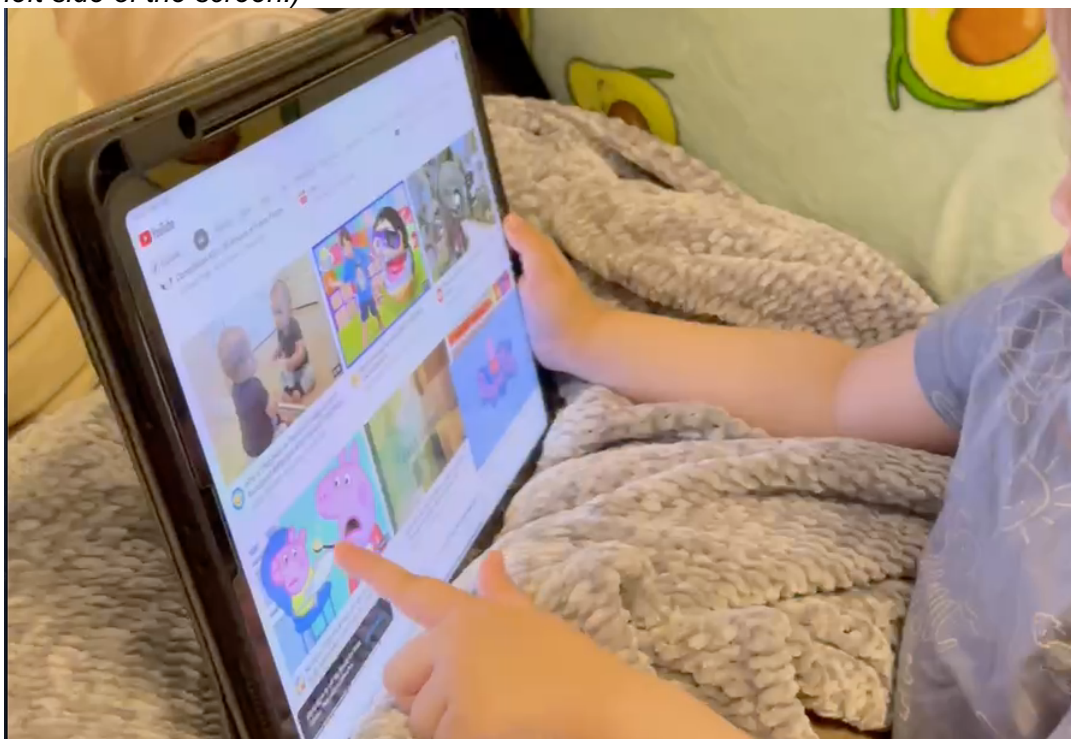

Image 20 Moe playing YouTube Kids app

(Moe opens that video and quickly swipes it away again. Then she chooses and opens another video, and then she looks at her mother for a second without

speaking. She laughs while watching this video with a young child.)
(Quote 4.3.35)

From this example, Moe did not speak and concentrated on choosing and watching videos that she found interesting. As the mediagrams were designed to illustrate Moe's language use and exposures in her touchscreen activities, the mother and I agreed to keep oral and written English in her touchscreen activity with *YouTube Kids* in the third mediagram.

4.3.4 Summary

As a three-year-old bilingual child, Moe's English and Chinese language developmental stages varied. For Moe, she might not be able to distinguish the two languages clearly. Her FLP was English-dominant, as her father was a monolingual English speaker, and her mother would use both English and Chinese when communicating with Moe. For Moe, one of the crucial ways for her to develop her language skills was through imitating her parents' language uses. Therefore, in all the data collected, Moe seldom spoke Chinese, and she communicated in fluent English for most of the conversations. A certain level of HL loss and language shift (Fishman, 2001) was found in Moe's case.

However, Moe's language practice did not mean that her mother did not want her to develop Chinese; she made efforts to create more Chinese language environments within her screen time, such as using Chinese subtitles and letting her use the app in the Chinese version. Meanwhile, her mother reported the difficulties of finding HL resources to support Moe's Chinese development. However, the lack of HL digital resources may be related to the limited digital knowledge (Little, 2019) and interests of checking and downloading the apps in Chinese.

When looking into Moe's language use during her touchscreen time, oral English was still dominant in Moe's interactions with both the screen contents and with her parents. Oral Chinese was practised less and only in limited activities, such as making video calls to the Chinese grandmother with her mother's accompaniment. Both written English and Chinese were rarely seen or used in most of Moe's touchscreen activities throughout the data collection. Besides, Moe's parents' positive attitudes towards touchscreen use led to various independent touchscreen time and activities for Moe. Among these activities, Moe's children's agency and preferences of playing apps were highly respected, and parents acted as gatekeepers to provide multiple supports. Apart from parent-child interactions during the co-use of certain apps, Moe also formed intensive imagery conversations with the virtual characters during her digital role play (Fleer, 2017) with certain gaming apps in oral English.

4.4 Tutu's case study

4.4.1 Introducing Tutu's case

Tutu was a three-year-old girl who was born and raised in southern England with her parents and her little brother, who was one year old. Both of her parents were Chinese, and Tutu was a Chinese-English bilingual who spoke the two languages in her daily life. Tutu had started going to nursery by the time of our second interview, and she had turned four years old by the time of our third interview. The family was recruited through the snowball method (Noy, 2008), word of mouth. I added the mother's personal contact account, and the details of the study were discussed through an online chat. The information letter was sent to the parents through email, and parental consent was obtained before conducting the study. Tutu's oral assent was gained each time before

and during the interviews.

Three interviews were conducted with Tutu's family; the total length of the interviews is about 2 hours and 40 minutes. All the three interviews were held with Tutu and her mother, and the interval between each interview was around one month. A language portrait activity was held with Tutu and her mother during the first interview. Six parent-recorded videos in total were sent to me. The first set of parent-recorded videos (five videos, 4.5 minutes in total) was sent to me after the first family interview, and the second set of parent-recorded videos (one video, 2 minutes) was sent to me after the second interview. Three evolving mediagrams of Tutu's language and touchscreen use were created and edited after conducting each interview and discussing them with the family.

4.4.2 Tutu's language choices

In Tutu's daily life, both Chinese and English were frequently used. Her language choice was influenced by many factors, such as her parental language habits and daily language exposure. Tutu's bilingual language use will be discussed in detail below, with her language portrait and other data collected from the interviews and the parent-recorded videos.

4.4.2.1 Language portrait (LP)

During the first interview, Tutu finished her LP painting with the help of her mother. When I asked Tutu to choose colours for Chinese and English, she seemed not to be able to distinguish the two terms for the two languages. Her mother helped her to understand the two languages by asking her to choose colours for the same vocabulary in both Chinese and English, just as the conversation extract below indicated:

R (Researcher)：你给中文选哪个颜色了呀，Tutu [What colour did you pick for Chinese, Tutu]？

M (Tutu's mother)：中文，'头'，选什么颜色呀 [For Chinese, 'head', what colour (do you) choose]？

(Tutu chooses a red pen.)

M：这个啊 [This one]？可以 [Ok]。

T (Tutu)：可以 [Ok]。

M：那 'head' 选什么颜色啊 [And what colour (do you) choose for 'head']？英文选什么颜色 [For English, what colour (do you) choose]？

R：英文呢 [How about English]？English 选什么颜色 [What colour (do you) choose for English]？

M: English?

T: English.

M：English 选什么颜色 [What colour (do you) choose for English]？再选一个 [Pick another one]。

T：要 black [(I) want black]！

……

R：中文是什么颜色啊 [What colour is Chinese]？

T：红色黑色 [Red (and) black]！

M：中文是红色 [Chinese is red]。

R：中文是红色 [Chinese is red]。

T：红色 [Red]！

R：英文呢 [How about English]？English?

M：英文是黑色 [English is black]。

T：黑色 [Black]！英文是黑色 [English is black]。
(Quote 4.4.1)

In the above conversation, Tutu's mother helped her choose colours for the two languages with a specific vocabulary that Tutu could understand in both Chinese and English. Instead of distinguishing the two terms, Chinese and English, Tutu could distinguish the two words with the same meaning in the two languages, '*head'* and '*头'*. As the second half of the above example showed, Tutu repeated what her mother said to reinforce her impressions for the colours that she chose for the two languages. Then Tutu imagined that the body silhouette was herself and finished most of the paintings individually with the two colours. As the LP painting below illustrated, Tutu painted a red dress, and the rest of the painting, such as the hands, feet, and facial features, were all painted black. Her mother helped her write down the names of the colours that represent each language in the *My Languages* column of the painting.

When we discussed why she painted the picture this way (see the picture illustrated below), Tutu did not explain the reasons for the way that she painted directly, but she did show her understandings between the colours and the languages through the following conversation:

T：这条 dress 是红色 [This dress is red]。

M：对，红色的 [Yes, (it's) red]。红色，你刚刚选的是不是代表中文的 [Red, did you just pick it to represent for Chinese]？

T：红色是中文 [Red is Chinese]。

R：是中文 [It's Chinese]。那黑色呢 [How about black]？

T：黑色是手手，还有…还有… [Black is hand, and…and…]

M：还有 head [And head].

T：还有 head, 还有 eyes [And head, and eyes]…
M: Eyes.
T：还有 nose [And nose]…
M: Nose.
T：还有 mouth, and its tongue [And mouth, and its tongue]!
(Quote 4.4.2)

In the first part of this extracted conversation, Tutu explained that she drew a red dress and said that red was chosen for Chinese, with the hint given by her mother. When I asked her about what the colour black in her painting represented, she said the Chinese word for hand at first. However, when her mother used the English word '*head'* to remind her that black represented English, Tutu then described her painting in black with English vocabularies, such as '*eyes'*, '*nose'*, '*mouth'*, and '*tongue'*. This change of

languages in Tutu's explanation does not necessarily mean that she could distinguish the two languages clearly, but it could indicate that Tutu understood the differences between the vocabularies in the two languages. As a three-year-old young bilingual, it could be challenging for Tutu to explain her understandings of her languages orally through an interview. The design of the LP activity is argued to be more interesting and less stressful for children than the format of a traditional interview (Tatham-Fashanu, 2021). However, the suitability of the LP activity for preschoolers is still worth considering. As the cognitive development stages from the preschool children to the elder children vary, whether the preschoolers could understand the instructions of this activity and visualise their linguistic repertoires to the same extent as the older children is questionable (Fashanu et al., 2020; Tatham-Fashanu, 2021). In Tutu's case, she showed her understanding of the two languages with the necessary support from her mother and with vocabulary that she knew in both languages.

Moreover, as the wavy lines of Tutu's utterance in the example show, she sometimes mixes the two languages in one sentence. However, this is only one pattern of Tutu's language practice; more about her language choices and FLP will be discussed with examples from other data in the following sections.

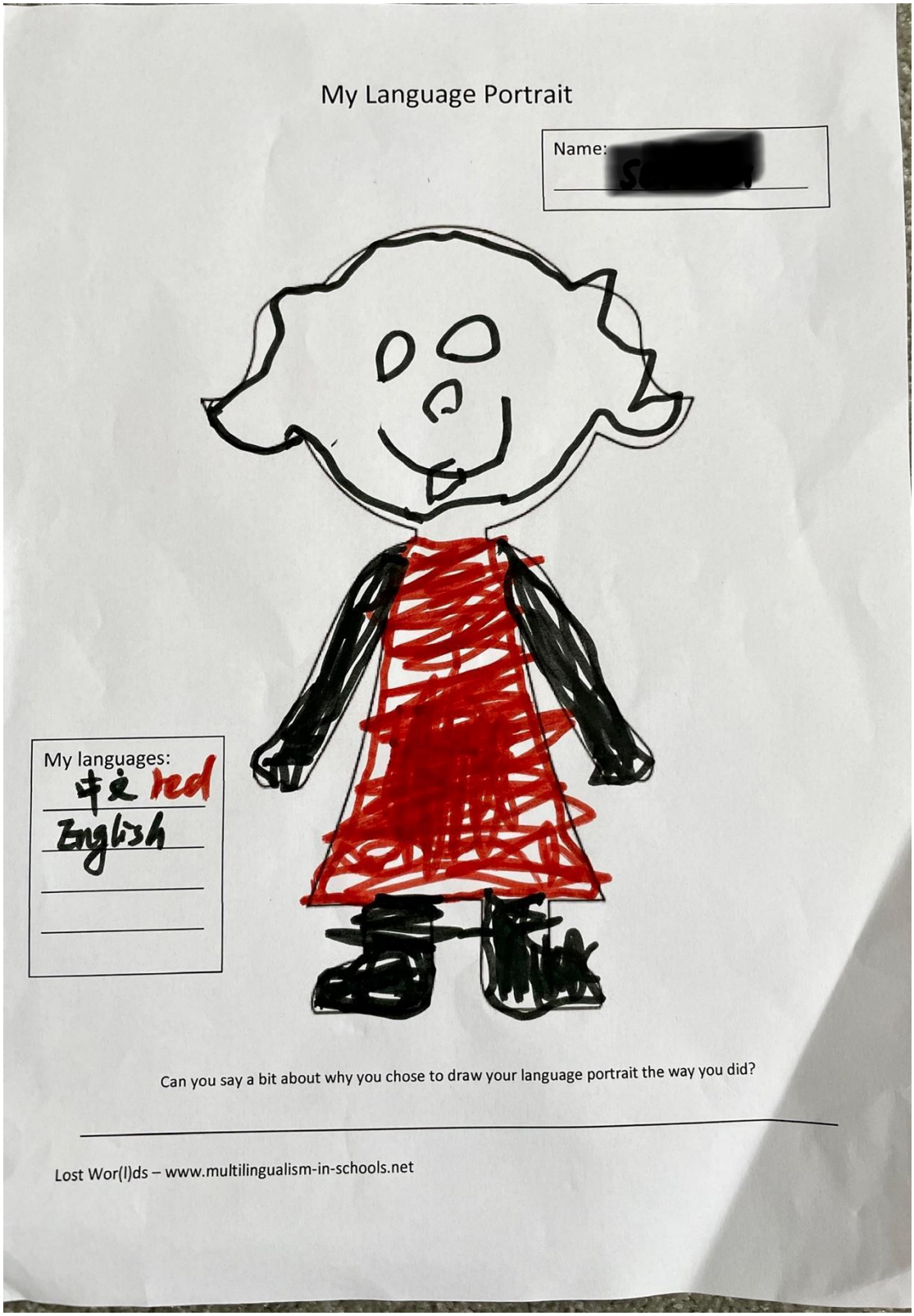

Image 21 Tutu's language portrait

4.3.2.2 Family language policy (FLP)

The FLP in Tutu's case did not change a lot during the data collection period. Both Chinese and English were used in Tutu's family life, with no strict language management rules separating the use of the two languages. As the above example conversation in the LP and some other example clips (see more examples in section

4.4.3) demonstrated, translanguaging (Song, 2016) practice was one typical feature of Tutu's language choice from time to time.

In the first interview, Tutu's mother reflected on their daily language use as below:

> *"她跟我们交流的话还是中文比较多，但是她会很多英文单词 [She (Tutu) speaks mostly Chinese when communicating with us, but she knows many English vocabulary]。因为她看动画片啊，或者是玩 iPad 会学到很多英文的，就她单词比较多 [Because she can learn many English (vocabulary) when watching cartoons, or playing iPad, she just knows many words]。…… 我们就是尽量讲中文 [We just try to speak Chinese (with Tutu)]。但是有的时候会被她带偏，她有时候会讲英文的，我们就是会中英文交杂在里面，就觉得英文她更懂一点 [But sometimes (we) may be misled by her, she sometimes speaks English, and we would mix Chinese and English during (communication); (we) think that she understands English better]。(Quote 4.4.3)"*

As the narration above indicated, the parents preferred to communicate with Tutu in mostly Chinese; however, they sometimes also mixed Chinese and English during their daily communication with Tutu, since they thought Tutu could understand English vocabulary better. Similar reflections on their FLP were found in the third interview:

> *M：就是可能觉得她英文会懂这个词的话，我会讲英文，就也随意吧 [(If I) just feel that she may understand this word in English, I would speak English, just very casually]。因为跟她讲话也很随意，有的时候想讲英文就讲英文，想讲中文就讲中文，没有刻意的说一定要中文还是英文这样子 [Because (I) talk to her very casually, sometimes (I) speak English if (I) want to speak English; sometimes (I) speak Chinese if (I) want to speak Chinese, I do not deliberately say whether (I) have to (speak) Chinese or English]。*
>
> *R：明白，就是以她能听懂为目的去跟她交流 [(Got it, just communicate with her with the purpose of making her understand] ?*
>
> *M：对对对 [Yes]。可能有一些词很习惯讲英文了，我们就跟她讲英文这样子 [Maybe we are very used to speak some words in English, we would speak English with her]。*
>
> *(Quote 4.4.4)*

From the dialogue above, the mother believed that the use of English and Chinese in their daily communication was rather casual; either language would be used to communicate with Tutu so that she could understand clearly. In Tutu's family, the communicational needs outweighed the attention to the use of specific language; translanguaging practices took place naturally during their family communication (Jung, 2022; Karpava et al., 2021).

However, being flexible about the use of Chinese and English in their daily communication did not mean that the parents did not value the maintenance of their HL, Chinese. In the second interview, the mother reflected on her language ideology and management strategies for maintaining Chinese:

> *"我有想过万一她就是以后去学校的话，我们就是尽量在家里跟她都讲中文，让她不要把中文给丢了 [I have thought that if she later goes to school, we would speak*

as much Chinese with her as possible at home; let her not lose (the ability to speak) Chinese]。不然以后跟爷爷奶奶不会交流 [Or (she) cannot communicate with (her) grandparents after (going to school)]。就这样子就可以了，其他的也就不强求了 [That would be enough, (I) do not force (her to master) other (Chinese skills)]。现在开始会给她讲一些中文的绘本，给她教认识一些字啊这种的 [From now, (I) would read some Chinese picture books for her, and teach her some characters]。" (Quote 4.4.5)

The mother's narration showed her awareness of potential risks of the HL loss after starting formal school life (Park et al., 2012). Entering school can be vital for HL-speaking children, since they may have limited time for HL exposure and need to achieve better school results in the dominant language (English in this case) (Huang & Liao, 2024; Liang & Shin, 2021; Little, 2019). Similar to some parents in other research with Chinese heritage families (Curdt-Christiansen & Morgia, 2018), Tutu's mother only set goals for Tutu's oral Chinese development, which was to fulfil the communication needs with grandparents, and lowered her expectation on Tutu's written Chinese literacy development. Compared to the time of the first interview, besides speaking with Tutu mostly in Chinese, more Chinese input was added in their FLP by the time of the second interview, such as reading Chinese picture books and teaching Tutu Chinese characters at home.

Like the other studies discussed above, parent-child interactions that took place regularly during their everyday life were the crucial proximal processes for Tutu's bilingual development (Bronfenbrenner & Morris, 2006). While Chinese was used most frequently in family communication, plenty of English words that Tutu understood were used in daily communication at the same time. As these interactions are bidirectional in nature (Tong & An, 2024), Tutu developed her bilingual skills through these kinds of proximal processes at a young age. Therefore, translanguaging (Charamba, 2020) practices of using both Chinese and English into one sentence took place during family communication, based on their actual needs of communication. The creative translanguaging practices in Tutu's case also indicated the creativity of her unique linguistic repertoire (Wei, 2018) and the important role of her Person characteristics on her bilingual development (Bronfenbrenner & Morris, 2006). Their FLP also indicated awareness and efforts to maintain Chinese. Imitating parental language use is a crucial way for children to develop their early languages (Bandura, 1977), and the family language environment is essential for developing languages in the early years (Bronfenbrenner, 1979; Siibak & Nevski, 2019). However, the rather stable FLP did not mean that Tutu's language choice was the same during the data collection; instead, her bilingual language capacities developed and changed throughout the time.

4.4.2.3 Tutu's developing bilingualism

Tutu's Chinese-English bilingual language capacities had been developing throughout the data collection period. As it was mentioned in the above section, Tutu's family mainly spoke Chinese with Tutu in their home environment, and sometimes they used English words and Chinese sentences together to meet the communication purpose. Therefore, Chinese was the main language that Tutu used in her daily life, and English was less used in her family communication. Her mother expressed similar views in both the first and second interviews, as she mentioned in the first interview, *"她现在完全是中文的思维方式，没有英文的，只是英文的单词而已 [Now her (Tutu) way of thinking is complete in Chinese and not English, (she) just knows some English words]"*.

And in the second interview, her mother emphasised this language choice of Tutu again, *"她跟我们基本上都说的是中文，就是会讲一两个英语的单词，但是不会完整的讲英语的句子，只是单词而已 [She (Tutu) basically speaks Chinese with us, (she) would just speak(s) one or two English words, but not say a complete sentence in English, only some words]。 (Quote 4.4.6)"*

The beginning of school helped Tutu develop her English skills. In the bioecological model, the beginning of school is a vital life event in the chronosystem (macrotime) (El Zaatari & Maalouf, 2022), the change of Time can significantly influence the proximal processes and further developmental outcomes (Bronfenbrenner & Morris, 2006). Before entering school, Tutu only knew how to speak some English words; she then started to speak some simple sentences in complete English at home after going to nursery for a while. As her mother said in the third interview, after starting school for around two months, she noticed that Tutu's English capacity had developed, *"会说好多句子 [(She) can speak many (English) sentences]。……刚刚上学的时候，回来没跟我们说过，现在慢慢的会说很多那种日常用语 [At first, when (she) just went to nursery, (she) did not say (English sentences) to us when she came back; now (she) gradually can speak many daily expressions (in English)]。(Quote 4.4.7)"*

As the example given by her mother in the third interview showed, *"她今天跟我们说，'I don't know' [She (Tutu) said to us today, 'I don't know']。(Quote 4.4.8)"*

In some cases, entering school may decrease a child's HL development since more time would be used to practise the dominant language for achieving better school performance (Little, 2019; Stewart, 2017). However, in Tutu's case, both her HL and dominant languages kept developing after she went to school. By the time of the third interview, Tutu's grandparents, who only spoke Chinese, came and visited Tutu's family. Tutu's mother believed that Tutu's Chinese skills also kept developing in their daily family activities. As she mentioned in the example below:

> *"奶奶会给她读书啊，会给她讲故事嘛，她最近会就是会复述我们讲的故事 [Her grandmother would read books for her, tell her stories, she (Tutu) recently would retell the story we told her]。……感觉以前读绘本都不是很看得懂，现在有种懂的感觉了她，会要求你一遍一遍地给她讲了 [(I) feel that (she) did not really understand when we read the picture book previously, now (I) have a feeling that she can understand, (she) would ask you to read for her again and again]。(Quote 4.4.9)"*

With her grandmother who was Chinese monolingual, Tutu developed her ability to retell stories in Chinese, and the mother believed that Tutu could comprehend better when reading the picture book at home by the time of the third interview. For Tutu, the activity of co-reading the picture books with her parents helped her early literacy development. She started to understand the content of the picture book. Besides, as the following example conversation from the third interview showed, Tutu could memorise and repeat the dialogue from a picture book together with the help of her mother in fluent Chinese:

> *M：嘟嘟，嘟嘟，我是卡车 [Du-du, Du-du, I am Truck]。我是卡车什么 [I am Track*

what]？

T：小红 [Xiaohong]！

M：我的 [My]？

T：工作送货 [Job (is) delivery]！

M：工作是送货 [Job is delivery]。什么，然后是什么 [What, then what]？

T：嗯 [Em]…

M：我今天我要到 [Today I will go to]？

T：狸猫叔叔家拉货 [Uncle Civet cat's home to pick up goods]。

M：好 [Good]！
(Quote 4.4.10)

From the example, although the underlines in the example show that Tutu was not correct in the grammar and her mother then corrected her, she could retell the dialogue in her picture book in complete Chinese with the hints given by her mother.

For Tutu, the beginning of school facilitated her English development, while the family activities, such as co-reading of Chinese picture books, helped her develop her Chinese as well. Therefore, both Tutu's bilingual capacities kept developing and growing by the time of the third interview.

4.4.3 Evolving mediagrams

After discussing Tutu's language choices in general above, more details about Tutu's bilingual development during her touchscreen use will be analysed with the three evolving mediagrams and other collected data as below.

4.4.3.1 Tutu's first mediagram

The first mediagram was drawn after having the first family interview with Tutu and her mother.

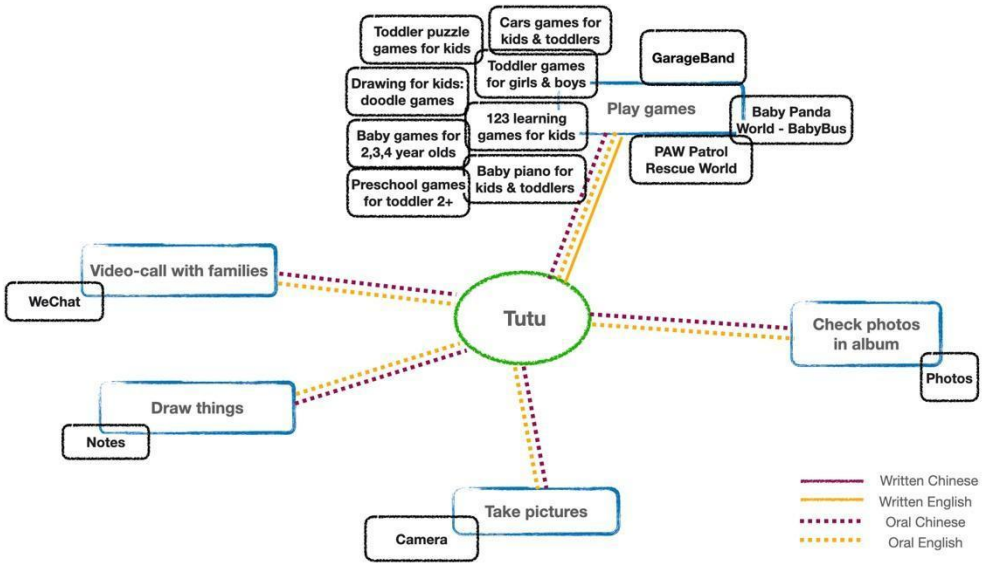

Image 22 Tutu's first mediagram

As shown in the first mediagram, Tutu's home touchscreen activities were diverse, such as playing gaming apps, taking pictures, checking the photo album, drawing, and making video calls. When discussing the apps that they downloaded for Tutu in the first interview, her mother said, "因为是这边下载的，所以就都是英文的 *[Because (the apps) are downloaded here (i.e. the UK app store), all (apps) are in English]。" (Quote 4.4.11)*

Therefore, written English could be seen during some activities, while no written Chinese was used during her home touchscreen activities. Some parents may encounter difficulties in discovering and finding suitable HL apps for their children within the app store (Little, 2019). Like in Moe's case, Tutu's mother stated that she could find few apps in Chinese and could only download many apps in English within the UK app store. However, it is not always the case that limited apps are available in heritage languages. This could be due to a lack of technical skills for exploring and downloading proper apps that are designed with multiple language setting options (Little, 2019).

For example, in the *Paw Patrol Rescue World* app that Tutu liked to play (see the example in Quote 4.4.12), 10 languages were available for this app, including both traditional and simplified Chinese. I downloaded this app and found that the language setting could be simply switched within the app (see the picture below).

Image 23 The interface of how to switch languages in Paw Patrol Rescue World

Besides this, for the other apps that Tutu used, except the *LeapFrog* electronic book that was designed in English, all the other apps could be switched to the Chinese version within the apps or within the device language setting option.

While no written Chinese was found in Tutu's touchscreen use, both oral English and Chinese were used in all her touchscreen activities. As it was discussed above, translanguaging (Karpava et al., 2021) sometimes was a feature of Tutu's language choice when communicating with the family. Similarly, both oral English and Chinese were used when she engaged with touchscreen apps.

For example, when Tutu demonstrated her favourite app *(Paw Patrol Rescue World)* in the first interview, the following conversation happened:

T (Tutu points at the green button in the middle of the screen): 这个绿色可以去玩

一玩 [This green (button), can go there to play]。

M：好，玩一玩吧 [Ok, go for it]。

Image 24 Tutu pressing the green button while explaining

……

M：你最喜欢谁啊 [Which character is your favourite]？这是 Chase，Chase 是什么 [This is Chase, who is Chase]？

T：Chase 是 blue [Chase is blue]！

M：Chase 是 blue，对 [Chase is blue, yes]。他是 policeman 是不是 [He is a policeman, isn't he]？

T: Yeah, policeman! Wow, 好多的 tree [Wow, many trees]! 这个是让这个 [This one is to let this]… 转一圈 [turn around]。然后吧，再拿去，然后再 [And then, bring (that) again, and then]…

M：它就是这样一个游戏，小孩子还挺喜欢 [It is just a game like this, children pretty like it]。

T: See，这样子 [See, like this]。

(Quote 4.4.12)

Image 25 Tutu demonstrating how to play Paw Patrol Rescue World

These intensive parent-child interactions can facilitate Tutu's bilingual development in her immediate environment (Bronfenbrenner, 1989, 2005). From the above conversation, Tutu and her mother used both English and Chinese in one sentence to communicate, as the wavy lines show. As mentioned in section 4.3.2.2, Tutu's translanguaging practices showed the influence of her characteristics on her bilingual language development. During the translanguaging practices, Tutu showed motivations to use both languages when communicating with her mother (forces), and she demonstrated her bilingual linguistic repertoire (resources) and the flexible use of both languages. Meanwhile, Tutu also used some complete Chinese sentences when she explained how to play the game (as the underlines show). However, except for the double-underlined sentence consisting of two English words, Tutu only used English words and not English sentences during this conversation. This example resonated with the discussions of Tutu's language choice above, that Chinese was the language mainly used during her daily communication, even when engaging with apps designed in English.

Like the above example, more intensive parent-child interactions between Tutu and her mother could be found during Tutu's touchscreen time (see more examples in 4.4.3.2 and 4.4.3.3). However, according to the mother, Tutu's touchscreen use was mostly independent, and they would let Tutu play her iPad if they were occupied by other chores. As the mother said in the first interview, *"我们平常都是在她，我们没法管她的时候，她就会玩 iPad 嘛 [Normally we would let her, when we could not look after her, she would play iPad]。她一看我在跟弟弟有事情，比如说在喂弟弟吃饭啊或者帮弟弟做什么的时候，她就会说她要去玩 [When she sees that I need to take care of her young brother, such as feed her brother or help him do something, she would say that she wants to go and play (iPad)]。(Quote 4.4.13)"*

For Tutu, playing touchscreen independently was a common pattern throughout the data collection period, her parents gave her freedom to play and explore the touchscreen device. For example, her mother said in the first interview, *"那个 Baby*

Bus 的很好，它就是里面所有的游戏都在里面，你就自己下就好了 [That Baby Bus (app) is great, it contains all games in one (app), you can download (games within the app) yourself]。她就想玩什么就自己下什么 [What she wants to play, she can download it herself]。(Quote 4.4.14)" Within an app that assembled many games, Tutu would download and play some games herself according to her own will. Her parents showed positive attitudes towards touchscreen apps and did not download apps for Tutu to meet educational goals but according to Tutu's interests of play.

However, while being open and positive about Tutu's touchscreen adoption, her parents also showed concerns about Tutu's screen use. As her mother said in the first interview, *"其实玩这个最担心的就是她眼睛，但是其他的我觉得都很好，就是玩电子产品啊 [Actually, (when Tutu is) playing this (i.e. iPad), the thing that I worry most is her eyesight, but other (aspects) I think are great, (I mean) for playing digital devices (in general)]。(Quote 4.4.15)"* Therefore, some restrictive parental mediation (Zaman et al., 2016) on Tutu's screen time was applied. As her mother explained, "*我们是给她每次玩，比如说三十分钟停一下啊，休息休息什么的 [Each time we let her play, for example, stop every thirty minutes and have a rest]。(Quote 4.3.16)"*

Beside this, other parental mediation (PM) strategies were also found during Tutu's touchscreen use. For example, although her parents let Tutu play iPad independently, they were aware of the potential risks of children's exposure to inappropriate contents and made efforts to mediate Tutu's touchscreen contents with the help of device and account settings. They only let Tutu use her own iPad, and as the mother explained about the children's account in the first interview:

> *M：我们还给她建了她自己的账号，那个 Google，不是有 Google Kids 嘛 [We set her own accounts for her, that Google has Google Kids, doesn't it] ?*
>
> *R：Google Kids 是她浏览的东西比较限制在对小孩子安全的内容 [Does Google Kids mean that she can only browse stuff that is limited to contents that are safe for children] ?*
>
> *M：对 [Yes]。然后她的所有的下载 app 啊，连 Apple 也有 Apple Kids [And (set children account for) all her app downloading, even Apple has Apple Kids]。就是她所有要下载的东西都要经过你同意，然后她玩那些东西的话，会先经过你同意这样子 [It's just that all the things that she wants to download have to be approved by you (i.e. the parents), then if she wants to play the apps, it will be approved by you first, like this]。*
>
> *(Quote 4.4.17)*

Building up a child account for Tutu indicated the technical knowledge that the parents held to facilitate their PM of selecting Tutu's touchscreen contents. With the help of child account settings, child protection settings inside apps, and the individual touchscreen device for Tutu, distant mediation (Zaman et al., 2016) was achieved, and the parents could still monitor Tutu's touchscreen use without accompanying her during her touchscreen use.

Compared with parental efforts towards the PM of the touchscreen contents, the

parents seemed to focus less on exploring the language choices of the apps that Tutu used with their digital skills. As discussed previously, the mother stated that the apps were downloaded in the UK and were in English. But for many of the apps that Tutu used, several language options, including Chinese, were available, and the language inside each app could be changed to Chinese within the iPad *Settings* or even within the app (e.g., the example of the *Paw Patrol Rescue World* app). Therefore, while the parents showed their awareness and technical knowledge of several mediational skills on Tutu's touchscreen use, they demonstrated little awareness on exploring the available languages of the apps that Tutu used. This indicated that her parents focused less on the design of apps language-wise, compared to other aspects of app design, such as the app contents and the child-protection function inside the apps.

4.4.3.2 Tutu's second mediagram

The second mediagram was amended based on the first mediagram and after having the second family interview and discussing the first set of parent-recorded videos (parent-recorded videos 1–5) with the family.

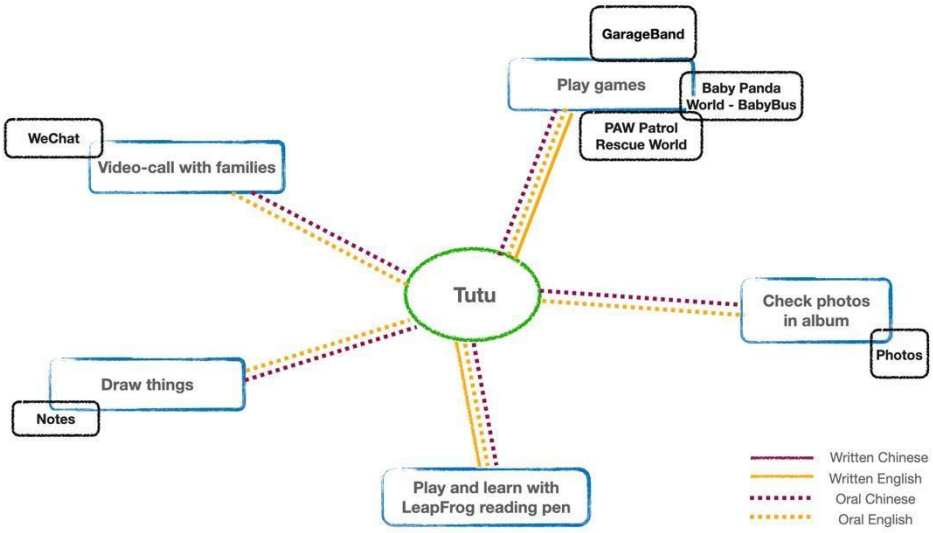

Image 26 Tutu's second mediagram

Compared to the first mediagram, Tutu's language choices did not change much in the second mediagram. However, her interests in some touchscreen activities changed. She stopped taking photos and did not play some games displayed in the first mediagram. A new device called *LeapFrog* electronic book was added to her touchscreen activities, with which she could use the reading pen to touch and engage with the e-book device. As shown in one of the parent-recorded videos below, the language setting of this electronic book was in written English only, and Tutu spoke English while playing it.

(Tutu is playing her LeapFrog Electronic Book. Her little brother is standing next to her and watching her play.)
B (background sound with music): One! Three.
T: Three…
M : 对 [Yes] , three。
(Tutu uses her touchscreen pen to click number 3 on the electronic book.)
……
B (with music): Six!
T: Six!

(Quote 4.4.18)

Image 27 Tutu playing LeapFrog electronic book

Although in this example, Tutu only repeated simple English vocabulary of numbers after the background voice. The mother said in the second interview that both oral English and Chinese are used in this activity, just like the oral language use of other touchscreen activities. Therefore, after negotiation, we added both oral English and Chinese to this mediagram.

For Tutu, just as in the first mediagram, both oral English and Chinese were used in her touchscreen activities in the second mediagram. With the first set of parent-recorded videos and the discussions during the second interview, more characteristics of Tutu's actual language use could be analysed.

First, while playing some gaming apps, Tutu sometimes did digital role play (Fleer, 2017) with some virtual characters in the apps. For example, when looking into the parent-recorded video 3, while Tutu was playing a game inside *Baby Bus*, the following conversation happened:

(Tutu is pressing the button and 'feeding' the animation character on the screen.)
B (Background voice, with music and animation of 'eating'): Ah…

Image 28 Tutu 'feeding' the animation character in the game

T (Tutu keeps 'feeding' the panda on the screen.): 你要吃，可以 [You want to eat, ok]！

T (Tutu watches the animation character and then looks at her mother.): 真好吃 [Very tasty]。

M：这是谁啊 [Who is this]？这是奇奇吗 [Is this Qiqi]？

T：奇奇要吃饭和肉肉 [Qiqi wants to eat rice and meat]。

B (with sound and animation): Noodle is a China…
(Quote 4.4.19)

Apart from interpersonal interactions, Tutu also frequently interacted with touchscreen apps independently. Like Moe, Tutu actively engaged with apps on her own and developed her languages during this kind of bidirectional proximal process (Bronfenbrenner & Morris, 2006). During this process, her agency played a vital role (Kucirkova, 2019) in facilitating her language practices with the help of touchscreen design that offered immediate feedback and turn-taking activities (Peebles et al., 2018). As shown in the above extract, Tutu was having imaginary conversations with the virtual character Qiqi in this game (see the wavy lines). She used her finger to press and 'feed' Qiqi while speaking to Qiqi in Chinese, the animation of Qiqi 'opened her mouth' responsively. The sounds and animation designs of apps and the interactive characteristic of the touchscreen (Dowdall, 2019) made it possible for children to form digital play while engaging with the touchscreen (Marsh, 2016).

With some digital prompts, children's imagination may lead them to form digital role-play and start imaginary conversations with some virtual characters (Fleer, 2017). As seen in this example, Tutu did not only talk to the non-human virtual character Qiqi during her digital role play in Chinese, she also responded and discussed the app contents with her mother (Bose et al., 2023). Both interpersonal communications, and interactions between Tutu and the touchscreen apps took place to influence her bilingual practices (Bronfenbrenner & Morris, 2006). Although this was an English app and the background voices were in English, Tutu spoke in complete Chinese while 'feeding' and communicating with Qiqi. Similarly, as the underlines indicate, Tutu also communicated with her mother and explained to her about the gaming contents in fluent and complete Chinese.

Second, it could be seen that Tutu was willing to share the contents of her touchscreen activities and form conversations. Intensive parent-child interactions were found several times, both in the interviews and in the parent-recorded videos. Like the example above of the communication between Tutu and her mother in the parent-recorded video, the following example was from the second interview when we viewed the parent-recorded videos together.

M：你看，你在玩什么 [You see, what are you playing]？在玩什么 [What (are) you playing]？

T：在玩这一个，做好吃 [(I) am playing this one, make delicious (food)]！

M：做好吃的啊，好吃的 cake 吗 [Make delicious food, delicious cake]？

R：哦 [Ah]。

M：你在做好吃的啊，哦 [You are making delicious food, ah]。

T：我又在 blend 吃的 [I am blend(ing) food again]！

……

M：mix 吗你是在 [Are you mix(ing)]？哇，cupcake，muffin，muffin man 吗 [Wow, cupcake, muffin, is it muffin man]？

T：嗯，是要做那个muffin man 的cake [Yes, to make a cake for that muffin man]。

M：哇，做了几个啊 [Wow, how many (did you) make]？

T：四个 [Four]！

M：哇，好厉害了你 [Wow, you did a great job]。

(Quote 4.4.20)

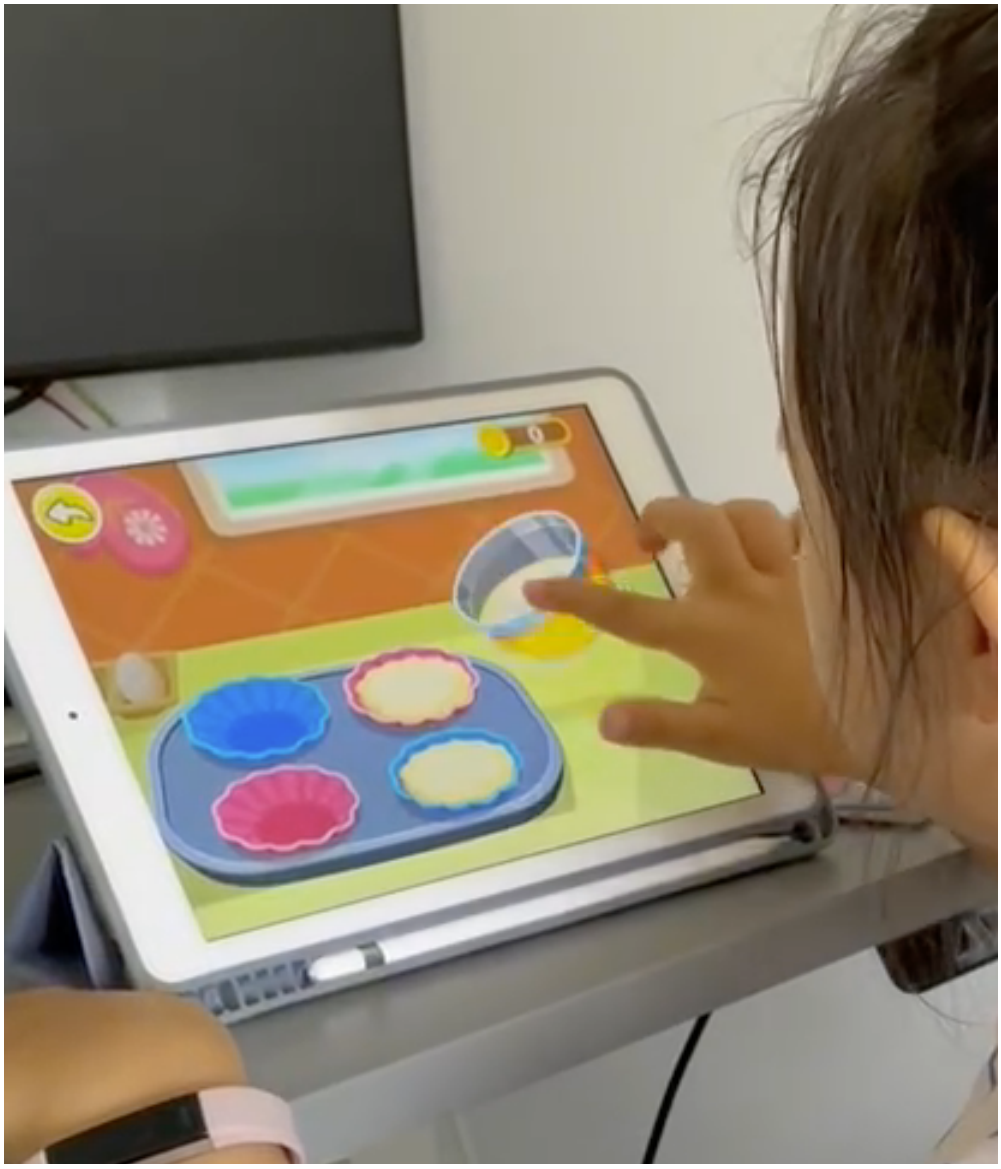

Image 29 Tutu making muffins in an app

From the above example, while watching her previous video of playing a touchscreen app, Tutu answered every question that her mother asked, and they formed intensive parent-child interactions around this video content. Both fluent Chinese (the underlines) and a mixture of English and Chinese (the wavy lines) were used in that conversation. One thing that needed to be clarified was that the similar parent-child interaction in this co-viewing activity did not only appear in the interviews but also in Tutu's daily home life. As Tutu's mother reflected on the communications during Tutu's touchscreen time in the second interview, *"她看动画片啊玩 iPad，她都会在旁边跟着讲的 [When she watches cartoons or plays iPad, she would talk about things accordingly]。……如果我们人在旁边，坐在她旁边干别的事情，她就会更加激动的，就一直会讲这个那个，这个那个 [If we are next to (her), sit next to her and do other things, she would get more excited, and would keep talking about this and that, this and that]。(Quote 4.4.21)"*

According to the mother's observation, Tutu was willing to speak when engaging with touchscreen activities and watching cartoons, even though they let her play touchscreen or watch programs independently. And Tutu was always willing to share

her thoughts about the cartoons or touchscreen contents if the parents were around. She would share her thoughts with her parents if they were present, without necessarily getting intensive responses from the parents. Therefore, the parent-child interactions and utterances in Tutu's touchscreen use were not only formed because they participated in my study; instead, this was a common phenomenon that took place in their daily lives.

In Tutu's case, she was willing to communicate with her parents if they were around when playing touchscreen games. Also, she would form digital role-play and practise languages during her touchscreen use herself. Both languages could be used during Tutu's parent-child interactions and her digital role play. Similar language practices of translanguaging and the frequent use of Chinese appeared during her touchscreen activities. Just as the above examples showed, sometimes fluent and complete Chinese was used, and sometimes translanguaging language use of both Chinese and English took place in these communications.

Moreover, although most of the time the parents would let Tutu play touchscreen alone, it did not mean that there were few parent-child interactions during Tutu's family life. They would prefer to accompany her to do some physical activities when they have time. As her mother said in the first interview, *"陪她的话，会陪她画画啊，看书啊，然后就各种玩 [(If we) accompanied her, (we) would accompany her drawing, reading books, and doing different sorts of play]。给她买了很多她的玩具，刚刚那个剪纸也是她的年纪 [(We) bought her many toys; the paper cut she just played fits her age]。还有拼图啊，就是很多很多适合她的玩具 [And puzzles, just many, many toys that suit her]。(Quote 4.4.22)"*

Research found that some parents preferred to choose to spend family time together with their children doing physical activity instead of screen activities (Sebire et al., 2011), and some parents in heritage families also mentioned that they preferred to let children develop HL through non-digital family activities (Hao, 2023). During these non-digital activities, intensive parent-child interactions could be found in Tutu's case, more about this will be discussed in section 4.4.3.3.

4.4.3.3 Tutu's third mediagram

The third mediagram was amended after having the third family interview and discussing the second set of parent-recorded videos (parent-recorded video 6).

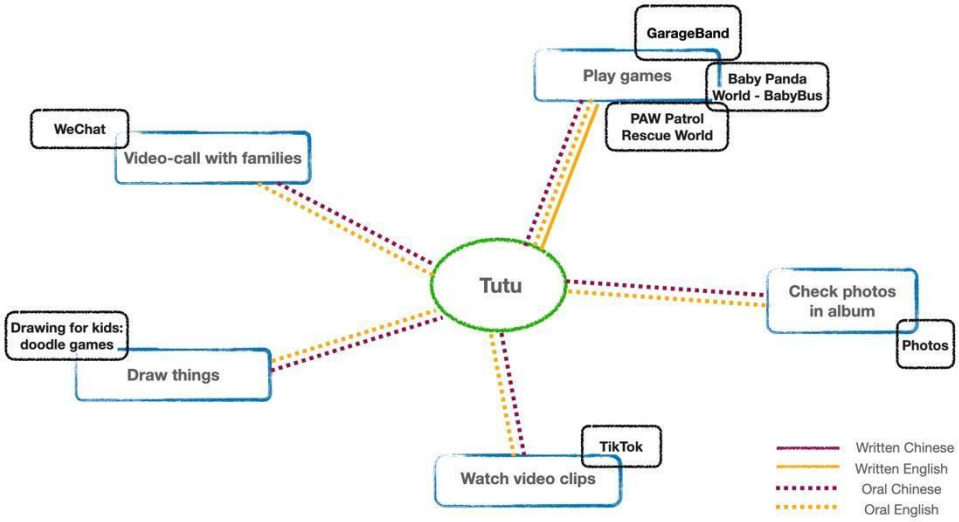

Image 30 Tutu's third mediagram

When drawing the third mediagram, another activity of watching video clips was added while Tutu stopped playing the electronic touchscreen book and reading pen. Besides that, Tutu started to use the Apple Pen as a new touchscreen tool and changed to use another app for drawing on her iPad. The activity of watching video clips via *TikTok* was introduced by Tutu's grandparents, who came to visit Tutu's family from China. Like the previous parent-recorded videos, Tutu's language use patterns did not change much, as illustrated in the following extract from parent-recorded video 6:

T (Tutu points at the cat animation on the screen and she clicks the cat with her right index finger.): 这又有 cat [There is (a) cat again]!
M: Hmm.
B (with sound and animation): You got victory!
(Change of animation and sound effects to show that she wins the game.)
T (Tutu gets excited and looks at her mother.) 我找到 cat 在这里 [I found the cat is over here]！
(Quote 4.4.23)

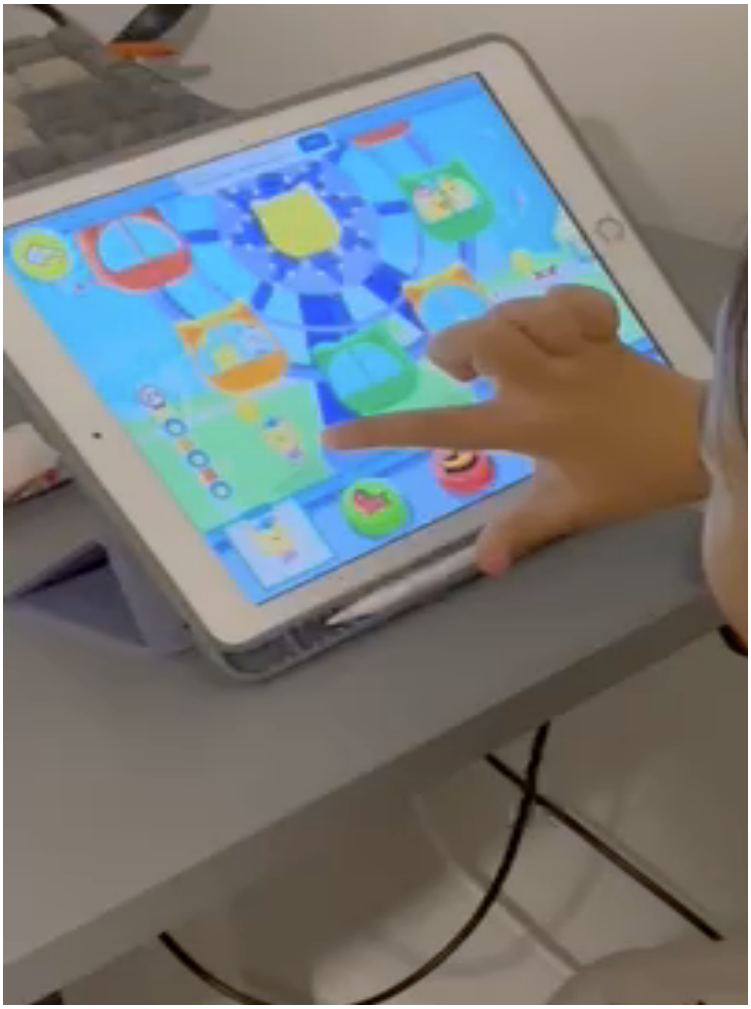

Image 31 Tutu trying to find a cat in a game

From the extract above, Tutu was willing to share her touchscreen game contents with her mother while her mother accompanied her, although her mother did not engage much during her play. Besides, the change of animation and encouraging background voice made Tutu feel proud to fulfil the mission in the game. With multimodal animation features, some children's apps are designed to let the child play in a responsive way (Marsh et al., 2018; Farrugia & Busuttil, 2021). Meanwhile, translanguaging appeared in this example, as the wavy lines above show.

Although the language use shown on the third mediagram was like the former two mediagrams, both the oral English and Chinese of Tutu had been developing according to her mother's observation. For example, in the second interview, her mother said that Tutu most of the time would just listen and show things to her grandparents without speaking during the video calls. But in the third interview, when talking about the activity of making video calls with the family, Tutu's mother said that, *"她还是英文和中文会都说的，因为她也分不清爷爷奶奶，外公外婆听不听得懂 [She still speaks both English and Chinese, because she cannot tell if her grandparents understand or not]。但是她现在感觉就是会交流的，会跟爷爷奶奶啊，外公外婆，会说话会沟通 [But she now feels like that she can communicate, (she) would speak and communicate with her grandparents]。(Quote 4.4.24)"* Although Tutu still mixed the two languages, the mother believed that Tutu could better communicate with her grandparents. This narration of the mother matched the findings that were discussed

previously in 4.4.2.3, that Tutu's bilingualism kept developing.

Another change in Tutu's touchscreen use was that her touchscreen time was reduced because she was more occupied by her school life and her grandparents would accompany her playing other games. As her mother said in the third interview, *"真的是没有时间玩这些东西最近，因为她上学回来也没多久就是要睡觉了 [(She) really does not have time playing these things recently, because she would go to bed not long after coming back from school]。(Quote 4.4.25)"*

Besides that, her mother emphasised in all three interviews that Tutu preferred to play with the adult family members instead of touchscreen devices if she could choose. As she said in the second interview, *"她其实更喜欢，比起玩 iPad，她更喜欢跟大人一起玩 [She actually prefers to play with adults instead of playing iPad]。(Quote 4.4.26)"* As playing jigsaw was one typical co-play activity between the parents and Tutu mentioned in the second interview, the conversation below between Tutu and her mother in the third interview could also support this point:

> *M：你喜欢玩 iPad，还是跟妈妈一起玩拼图，玩画画 [You like to play iPad, or play jigsaw, play drawing games with mama]？*
>
> *T：拼图 [Jigsaw]！*
>
> *(Quote 4.4.27)*

Therefore, the engagement with touchscreen activities was only a small part of Tutu's family life; there were other physical activities that she preferred to do with her family members. When comparing Tutu's language development during her digital activities and physical activities, her mother reflected in the third interview as below:

> *"感觉跟人学的会正确一点，她就是现在语言的话基本上要不就是跟学校老师学的，要不就是跟我们学的 [(I) feel that developing (languages) with people can be more accurate; she now develops languages basically from school teachers, or from us]。还有她看动画片里的话，就是那里面单词会比较多一点 [And when she watching cartoons, there are more vocabulary (in cartoons)]。(Quote 4.4.28)"*

Although Tutu practised and developed both languages, especially new English vocabulary, her mother believed that Tutu developed most of her bilingual language skills through communicating with people and learning from real-life scenarios. Communicating with family members and school teachers who are essential parts of her microsystem influences her emergent literacy development (Bronfenbrenner, 1994). Compared to imitating family members' and teachers' language use, developing languages through touchscreen use seemed to be more random and lacked consistency. Just as the mother said, Tutu might only acquire some new vocabulary but not complete language expressions when watching cartoons.

4.3.4 Summary

The language choices of Tutu were complicated. In most of the cases, Chinese was the main language for Tutu to think and communicate during her daily interactions and touchscreen activities. Sometimes she would speak complete Chinese sentences but sometimes she mixed both Chinese and English words together to communicate. According to the LP activity, Tutu could not clearly distinguish or separate the two

languages. The translanguaging (Charamba, 2020) feature of her language choice was also seen in all three mediagrams and her touchscreen activities. The FLP of Tutu did not strictly form rules on the use of specific languages; instead, the family communicated in both Chinese and English in a casual way, with the main purpose of making smooth communication.

When discussing Tutu's bilingual development during her touchscreen activities, the language use was similar. Both oral English and Chinese were frequently used in all her touchscreen activities. Since all the apps that Tutu used were in English, no written Chinese was found in her touchscreen use, and written English exposure was found in some gaming apps. Instead of making the touchscreen an educational tool, Tutu's parents gave her freedom and respected her interests in choosing apps with some parental mediation strategies. Their PM on the screen contents was achieved with the help of setting child-protective accounts and separated touchscreen devices for Tutu. Limited within a child account, Tutu downloaded most of the apps according to her own interests and played for entertainment.

When looking into Tutu's bilingual language development throughout the data collection, both her bilingual language skills had been developed gradually. By the time of the third interview, the beginning of nursery helped Tutu develop her oral English capacity. Tutu could speak more English at home compared to when she did not go to the nursery. Meanwhile, her Chinese skills were also developing through her family activities and communications. At this stage, Tutu mainly practised her oral language skills through varied family activities (both digital and physical ones) and some school activities.

Throughout the data collection, Tutu's interests in some touchscreen activities and apps came and went, but the language use patterns were rather stable. Digital role play and imaginary conversations with virtual characters were found in Tutu's touchscreen use. Although only in a few cases her parents would accompany Tutu during her touchscreen time, Tutu showed great interest in sharing and forming intensive parent-child interactions about her touchscreen contents. In general, with the multimodal interactive touchscreen designs, Tutu practised both languages and entertained herself during the touchscreen time. Although all the apps she played were in English, Tutu's language practice was similar to her language use in non-digital activities. While Chinese was still the dominant language for Tutu to speak while playing these apps, translanguaging took place from time to time.

4.5 Vicky's Case Study

4.5.1 Introducing Vicky's case

Vicky was a five-year-old girl who was born and raised in middle England; she lived with her parents and an older brother, who was nine years old. Both of her parents were Chinese, and Vicky spoke Chinese and English daily. By the time of the first interview, Vicky had just finished her reception year. By the time of our second interview, Vicky started her Year 1 journey at school and started attending Chinese weekend classes in her spare time. The family was recruited via the network of a heritage language school, emails were sent to parents who connected to this school, and Vicky's mother showed her interest in participating in the research. The information letter was sent to the mother, and a brief online phone call was made to explain further about the research. Parental consent was signed and received, and Vicky's oral assent was gained each time before and during the interviews.

The total length of the three interviews that were held with Vicky's family was about 2

hours and 50 minutes. The first two interviews were held with Vicky and her mother, and the third interview involved Vicky, her mother, and her elder brother. The three interviews were held every one and a half months. Two sets of parent-recorded videos were sent to me during the intervals of the interviews (two sets of videos, 10 video clips, 6 minutes in total). Three evolving mediagrams of Vicky's language and touchscreen use were drawn and amended after conducting each interview with the family.

4.5.2 Vicky's language choice

As a Chinese-English bilingual child, Vicky spoke the two languages in her daily communications. Her language choice was influenced by various factors, such as the language habits. Her language use will be analysed in detail in the following sections.

4.5.2.1 Language portrait (LP)

The language portrait (LP) activity was conducted with Vicky and her mother during the first interview. Before starting to draw the LP picture, we talked about the languages that she used, as the following conversation showed:

M (Vicky's mother)：你说什么语，平时 [What language do you speak, usually]？
V (Vicky): Hmm…
M：她不知道叫什么 [She does not know what it is called]。说中文是吧 [Speak Chinese, right]？
V：中文 [Chinese]。
R (Researcher)：那你都跟谁说中文呀 [So, who do you speak Chinese with]？
M：一般都是跟谁说中文 [Who (do you) speak Chinese with usually]？
V：跟哥哥说 [With (my) brother]。
R：跟哥哥说 [With (your) brother]。然后呢，还有别人吗 [And then, any other people]？
V：还有跟妈妈说 [And (I) speak (Chinese) with (my) mom]。
R：跟妈妈说，还有吗 [With (your) mother, is there any more (person)]？
V：跟爸爸说 [With (my) dad]。
……
R: When you speak English, who do you speak English with?
V：我上学的时候说 [I speak (English) when I go to school]。
R：上学，在学校里 [Go to school, in school]。
(Quote 4.5.1)

In the above conversation, with the help of her mother, Vicky said that she spoke Chinese with her parents and elder brother at home and spoke English at school. As a child who just finished her reception year at that time, although Vicky was not familiar with the term Chinese, she could clearly distinguish the different scenarios in which she spoke Chinese and English.

After that, Vicky chose purple to represent Chinese and red for English during her LP drawing. However, when we talked about her painting in the follow-up conversation, Vicky did not explain her painting by connecting colours with the languages:

M：那为什么画在这儿，你觉得 [So why you paint it there, you think]？

V：因为喜欢 [Because (I) like]。

……

M：喜欢紫色是不是 [You like purple, right]？

(Vicky nods.)

M (Vicky's mother points at the dress straps that Vicky painted in red and asks)：那你为什么，这个红色的是什么 [So why you, what is the red (here) for]？

R：你也喜欢红色吗 [Do you also like red]？

V：(Vicky nods.) 我不想让裙子掉下来 [(The red straps are drawn here because) I don't want the dress to fall]。

(Quote 4.5.2)

Combining the above conversation with Vicky's painting below, she designed the painting in a way that she liked but not closely connected the colours with the languages. Although Vicky did not clearly demonstrate her perceptions of languages, it encouraged Vicky to speak more about her thoughts and engage more in the following interviews. According to research, engaging children in exercise-based LP activities sparks greater interest and reduces stress compared to conducting traditional interviews (Tatham-Fashanu, 2021). In Vicky's case, the LP activity worked well as an ice-breaking activity. Vicky was quite shy at the beginning of the first interview and did not speak much at the beginning; after doing the LP activity, she expressed herself more in the following interviews. For example, she demonstrated her emotional attitudes about the two languages in the below conversation after doing the LP activity in the first interview:

M：你跟姥姥或者爸爸妈妈哥哥说中文的时候，就是我们现在说的这个语言，这样说话你开心，还是在学校跟老师说话开心 [When you speak Chinese with (your) grandma, dad, mom or brother, it is the language we speak now; are you happy to speak this way, or are you happy to speak with teacher at school (in English)]？

V：都喜欢 [(I) like both]。

M：都喜欢，哪个更喜欢 [(You) like both, which one (do you) like better]？

V：跟妈妈说 [(The one I) speak with mom]。

M：跟妈妈说的，跟妈妈说的中文 [Speak with mom, (you) speak with mom in Chinese]。

(Quote 4.5.3)

Vicky said that she liked speaking both languages, and when her mother let her choose her favourite one, she chose Chinese as it was the language that she spoke with her mother. HL can serve as a connection that strengthens family relationships and promotes the acknowledgment of a person's cultural heritage and self-identity (Little, 2019; Shen & Jiang, 2021; Wang, 2023). The above conversation demonstrated that Chinese could be closely related to the sense of family bonds and emotions, since Vicky said she liked the language she spoke with her family members and felt happy when speaking Chinese.

Moreover, as a young bilingual child, Vicky's actual language use was more complicated than she identified, see more discussions in the following section about

her FLP.

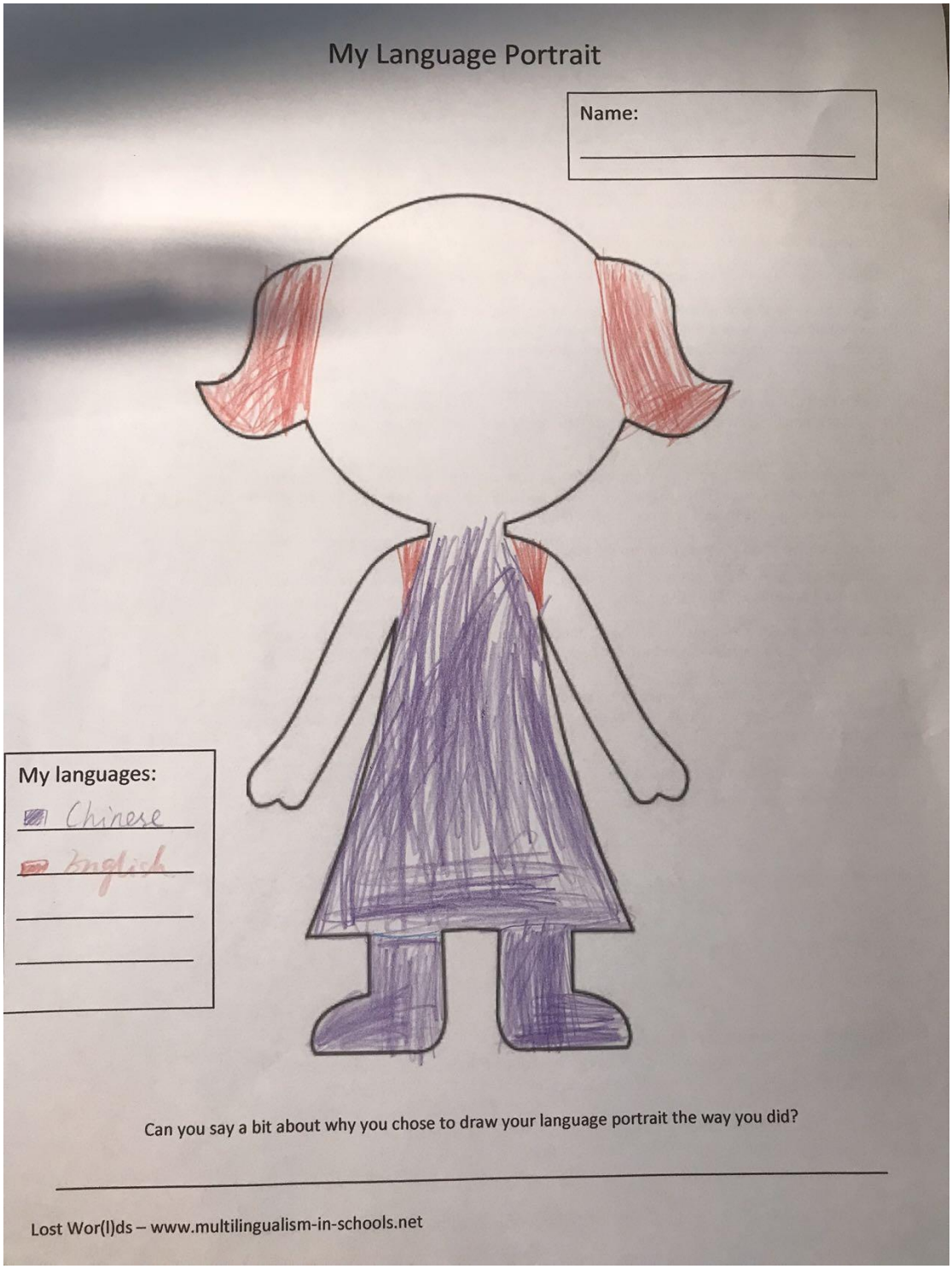

Image 32 Vicky's language portrait

4.5.2.2 Family language policy (FLP)

Throughout the data collection period, Vicky's family language policy (FLP) was rather stable and fixed. First, Chinese and English were used in their everyday family communication. As the mother said in the first interview,

> *"如果是用英语就都是英语，然后如果是用中文就都是中文 [If (we) use English, then (we speak) all in English, and if (we) use Chinese, then (we speak) all in*

Chinese]。(Quote 4.5.4)

The parents communicated with Vicky and her brother mainly in Chinese, and their language habit was to not use the two languages together when communicating with Vicky. Meanwhile, Vicky and her brother communicated with each other in both Chinese and English, and translanguaging (Charamba, 2020) took place during the siblings' daily conversations. As Vicky reflected in the second interview:

R：在家里，是你和哥哥是只说中文，还是中文和英文 [At home, do you speak only Chinese with your brother, or Chinese and English]？

V：中文 [Chinese] and 英文 [English]。

R：中文 [Chinese] and 英文 [English]。那你跟爸爸妈妈呢 [How about you with father and mother]？

V：也说中文 [AIso Chinese] and 英文 [English]。

M：他们两个就是混着说 [They (Vicky and her brother) mixed the language when speak]。……着急就开始两个人说英文 [They speak English when they are in a hurry (i.e. eager to express themselves)]。但是有些话比如说他们常说的，就用中文 [But for something they always say, (they) just use Chinese]。

……

M：哥哥跟你说中文多还是英文多 [(Your) brother speaks with you in Chinese more or English more]？

V: English more!

(Quote 4.5.5)

In this conversation, by the time of the second interview, Vicky developed her knowledge in understanding and using the two terms that represented Chinese and English, which she could not do in the first interview.

The below conversation clip extracted from the third interview gave a clearer explanation of Vicky's language habit mentioned in the above paragraph. This conversation took place when Vicky and her brother talked to me about their favourite comic book, *Dog Man*.

V：我给你看那个 [I want to show you that] most funny one!

B (Vicky's brother)：那个 Dog Man 是，有一个人和一个狗 [That Dogman is, there are a man and a dog]。他们在坏人家里头，他们发现个炸弹，这样 [They were at a bad guy's home, and they found a bomb, like this]。

R：哦，一个人和一只狗 [Oh, a man and a dog]。

B：他们那个 [They]，不让它炸 [did not let it explode]，work?

M：哦，不让它爆炸 [Oh, (they) did not let it explode]。

B: So, they defuse it. They didn't mean to defuse it and explode it. They went to hospital…

V (Vicky gives the comic book that they talked about to her brother and asks): Where's the song one?

B: The song one?

(Quote 4.5.6)

As in the above example, translanguaging (Wei, 2018) between Chinese and English was shown when Vicky (see the wavy lines of Vicky's utterance) wanted to show me the content of a comic book. Compared to Vicky, her brother and her mother spoke fluent Chinese sentences (see underlines) when they explained the book content. The brother also spoke complete English sentences when explaining the more details of the book content (see the double-underlines), and one sentence in both languages as he did not know the Chinese expression of 'explode' (see the wavy line of the brother's utterance). When the siblings communicated with each other, they spoke fluent and complete English (see the double-underlines). Combining the mother's and Vicky's narrations and the example conversation clip above, for the siblings, English was the preferred language if they were eager to express something they did not usually speak in daily life. As Vicky said, her brother communicated with her in more English than in Chinese.

Moreover, translanguaging was one typical feature of Vicky's language use throughout the whole data collection. Another example was when she explained to me about the rewards she got when using the app *IXL Learning*, she said, *"有些 animal，我那次拿了 animal sticker [There are some animal(s), I once got (an) animal sticker]。Year 1 我有一些 golden stars [I got some golden stars in Year 1]。(Quote 4.5.7)"*

In Vicky's case, both languages were used to express herself in many situations (see more examples of Vicky's translanguaging language use in section 4.5.3). Her linguistic repertoire should be viewed as whole and unique and not divided by the named languages (Wei & García, 2022). This language use pattern will be further explained in section 4.5.3.2.

Moreover, Vicky's language choice could be influenced by her different levels of language capacity in Chinese and English. As her mother explained in the first interview, "*她不知道中文怎么说的时候可能用英文 [She may use English when she does not know how to say (things) in Chinese]。(Quote 4.5.8)"* Also, Vicky reflected about the languages in the video-watching activity in the second interview; she said, *"If 是中文的，我听不懂了 [If (the video) is in Chinese, I do not understand]"。 (Quote 4.5.9)*.

Furthermore, Vicky's different levels of language capacity in English and Chinese could be affected by several factors. On the one hand, although the parents showed a positive attitude about Chinese maintenance, their FLP was mainly about creating an oral Chinese environment at home through their natural communication, not other specific language management actions. As the mother said in the second interview about Vicky's Chinese development, *"就是不想让她现在压力太大 [(I) just do not want her to be too stressed out now]" (Quote 4.5.10)*.

Although Vicky started going to Chinese classes on weekends by the time of the second interview, it was out of her own interests, not the parents' requirement. As her mother explained, *"本来想今年先等一年，然后她去试了一次课就特别喜欢，那我说那你就上吧 [(I) had thought to wait for another year (before letting her attend Chinese classes), then she went to the trial class once and loved it, so I said 'you can (attend the class)']。(Quote 4.5.11)"*

On the other hand, Vicky was exposed to the English environment more than the Chinese environment in her daily life. As her mother reflected in the third interview, *"因为在学校有时候会待到六到八个小时，回家就这么两三个小时就该睡觉了 [Because (Vicky) stays in school for about 6 to 8 hours (a day) and (she) should go to bed after coming home in about 2 to 3 hours]。所以说英文就会比较多一些 [So (Vicky) speaks more English]。(Quote 4.5.12)"*

The beginning of school, which is a life-changing event at macrotime level (Bronfenbrenner & Morris, 2006), influencing the developing child's bilingual development (Guo & Lee, 2023).The starting of school is sometimes a turning point for children who speak a heritage language, as they may decrease their exposure to their HL and spend more time developing their dominant language skills for school achievements (Curdt-Christiansen & Morgia, 2018; Little, 2019). For Vicky, as she started going to school regularly, the contexts where she primarily practised languages also changed (Bronfenbrenner & Morris, 2006), interactions in the school settings became another microsystem alongside the home environment. She spent most of the day in school speaking more English and had less time to practise her Chinese at home after coming back from school on weekdays. However, different from some Chinese heritage children who were reluctant and felt pressure to practise Chinese (Wang, 2023), Vicky demonstrated a positive attitude towards Chinese and asked to attend weekend Chinese class voluntarily.

Looking through the bioecological lens (Bronfenbrenner & Morris, 2006), while being aware of the change of time and context, Vicky's bilingual development is mainly influenced by various proximal processes in home, school, and community school environments. These proximal processes involved interpersonal interactions with different people, such as with parents, her elder brother, teachers, and peers. Among these processes, Vicky's characteristics (Bronfenbrenner & Morris, 2006) actively influenced her language choices and development. Vicky showed clear motivation and interest in developing Chinese as she asked to attend weekend community school voluntarily (forces); she could also clearly distinguish the different scenarios in which each language applied (resources). From the above analysis of Vicky's FLP, although the parents set rules for themselves of mainly speaking Chinese and in completely Chinese or English once a time with the children, they did not set strict language use rules for the children. The parents did not require the child to maintain the same language use habits as themselves and respected their translanguaging practices. For Vicky, both Chinese and English were often used together when she wanted to explain something and communicate with her family members (forces and resources). This flexible language choice of Vicky indicated that not only the parents but also the child played an active role in forming and influencing their FLP (Shen & Jiang, 2023; Wilson, 2020). For Vicky, although the translanguaging practice itself does not indicate a stronger or a weaker language (García & Otheguy, 2020), this kind of language practice demonstrates how Vicky actively and creatively engaged with her unique linguistic repertoire during interactions (Wei, 2018).

4.5.3 Evolving mediagram

After discussing the general patterns of Vicky's Chinese-English language choice, her bilingual language use and development will be analysed through the lens of her home touchscreen activities. The following three mediagrams of Vicky's bilingual language use during her varied home touchscreen activities were developed step by step, after conducting each family interview with the family.

4.5.3.1 Vicky's first mediagram

The first mediagram captured four touchscreen activities that Vicky mainly did by the time of the first interview, and there was an app used for each activity. Through all the activities, oral language exposure was the main feature. Oral English was used during all four activities, and written English appeared in Vicky's two main touchscreen activities, watching videos from *YouTube Kids* and learning maths and English with the *IXL Learning* app. No written Chinese was found in her first mediagram of touchscreen use. Compared to the English exposure, Vicky's touchscreen time included limited Chinese resources.

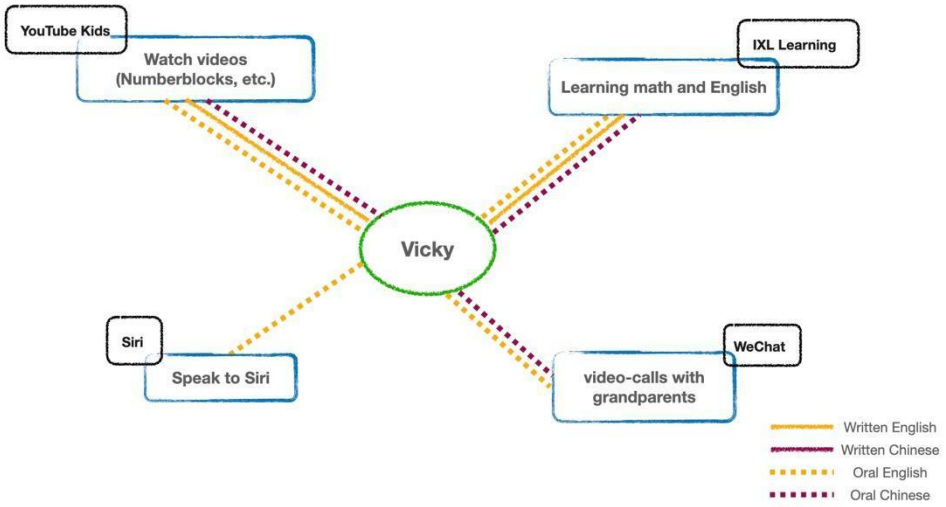

Image 33 Vicky's first mediagram

For example, using the *IXL Learning app* was one of the most frequent touchscreen activities of Vicky, and English was the dominant language of this activity. As her mother said in the first interview, *"IXL 是数学和英语的一个网站，然后它是动画的 [IXL is a maths and English website and it is with animations]。所以她每天都要做题 [So she does the exercises everyday]。(Quote 4.5.13)"*

This *IXL Learning app* came from a paid learning website; the language used in the app was English for the UK website and app. Her mother believed that it was a good app for Vicky to develop her English literacy and maths skills and made this activity Vicky's main touchscreen activity that she could engage with every day. I checked the language settings for this app; there were 5 more language options except English, but there was no Chinese option.

Vicky used the *IXL Learning app* frequently throughout the data collection periods, and the co-use between Vicky and her parents or Vicky and her brother, was one typical feature of this activity. As discussed in the third interview:

> *R：您说的那个做题 app，是每天都还都在用吗 [That app for doing exercises, does (Vicky) still use it every day]？*
>
> *M：对，每天都在做 [Yes, do (exercises) everyday]。尤其是我们两个都没发监督她学习的时候，就让她来做 [especially when the two of us (i.e., the parents) do*

not have time to supervise her study, (we) let her do (that)]。然后哥哥给她打开，就帮着妹妹也做 [And her brother opens it for her, helps her do (exercises) as well]。(Quote 4.5.14)

As a learning app, it functioned as an alternative way of helping the parents monitor Vicky's maths and English learning. As the gatekeeper (Little, 2020) for Vicky's touchscreen use, the mother considered less about the entertaining feature and stressed on the educational benefits when selecting this app for Vicky.

In addition, the co-use activity with her brother indicated scaffolding and siblings' communication. Literature points out that older siblings may often assist younger ones in their media use when things are challenging for the younger children to manage (Siibak & Nevski, 2019). As a young child, Vicky lacked the ability to operate and needed more help to use this app. As her mother explained in the second interview, *"Vicky 主要还是要带着她，偶尔的会自己能做 [For Vicky, most of the time (we) need to help her, only occasionally she can do (exercises) herself]。大部分我们会带她（做题），有时候哥哥也会带她 [Most of the time we would help her (do exercises), sometimes her brother would help her as well]。(Quote 4.5.15)"*

Considering the translanguaging feature of Vicky and her brother's communication, the family and I discussed and added oral Chinese to Vicky's use of *IXL Learning* in the mediagrams as well, alongside the main language English.

Similar language practices could be found when discussing the languages that Vicky used when watching videos. From her mother's narration and Vicky's own words in the first interview, one feature of her video-viewing activity was *"有时候跟哥哥一起 [Sometimes together with (my) brother]" (Quote 4.5.16)*. The co-viewing and co-use with her brother during Vicky's touchscreen activities were frequently mentioned throughout the interviews.

Compared to the co-viewing activity with her brother, little parent-child co-viewing was found in Vicky's case. Similar findings are found in other research, watching media content together with a sibling commonly occurs more often than with parents (Nevski & Siibak, 2016). Due to Vicky and her brother's different interests towards videos, they negotiated while watching videos. When we watched and discussed the parent-recorded video 2 during the second interview, the following conversation took place and showed the pattern of their co-viewing activity:

R：这是什么呀 [What is this]？

V: Pokémon!

M: Pokémon. 谁让你选的 [Who let you choose this]？

V：哥哥 [(My) Brother]！

R：是哥哥喜欢 Pokémon，还是你喜欢 Pokémon 呀 [Does (your) brother like Pokémon or do you like Pokémon]？

V：哥哥喜欢 [(My) Brother likes]。

R：所以有的时候你会选哥哥喜欢看的东西是不是啊 [So sometimes you may choose the content that (your) brother likes to watch, isn't it]？

V：有时候我们，哥哥看一个，我看一个 [Sometimes we, (my) brother watch one, (then) I watch one]。

R：你们商量好了对不对 [You know how to negotiate, right]？

V：嗯 [Yes]。

(Quote 4.5.17)

When Vicky liked to watch some cartoons herself, her brother might prefer videos with other contents, such as gaming videos. Viewing contents that are preferred and introduced by an elder sibling may pose a risk of viewing age-inappropriate content (Siibak & Nevski, 2019). In Vicky's case, she did not like game videos but would watch them together with her brother. Since the only app that they used to watch videos was *YouTube Kids* and their father set time and content limits inside this app, the mother trusted the filtered content and did not show concerns about whether Vicky would be exposed to some potential age-inappropriate content. With the help of an in-app timer and content filter, Vicky's parents used the distant mediation (Zaman et al., 2016) strategy to monitor their children's screen-viewing activity without being involved in the siblings' co-viewing activity.

As mentioned in section 4.5.2, translanguaging happened sometimes when Vicky spoke; therefore, both oral Chinese and oral English were also used occasionally in her video-viewing time and were added in the mediagrams. Besides this, almost all the videos they watched were in English. As the following conversation in the first interview illustrates:

R: 你在 iPad 上面看视频，都是英文的吗 [When you watch videos on iPad, are (they) all in English] ？你会点开中文的视频吗 [Will you click on any videos in Chinese]？

V：我不知道怎么说 [I don't know how to say]。

M：你看过一些什么动画片，说的话跟姥姥说话是一样的吗 [Have you ever seen any cartoons, that speak the same language as you speak to your grandmother]？

V：没有 [No]。

(Quote 4.5.18)

From this conversation, although Vicky could not identify the term Chinese, she could distinguish her HL as the language she spoke to her family member. The possible reason for only watching videos in English maybe related to her brother's language choice, as her mother reflected in the first interview: *"因为中文有时候会听不懂，他们在一起听英文会比较顺畅 [Because sometimes (they) cannot understand if they listen to Chinese, it is smoother for them to listen to English together]。主要有时候是哥哥看，她也就跟着在旁边看，哥哥看的一般看英文的比较多 [Mostly her brother watches (videos), then she stays there and watches; her brother usually watches mostly English (videos)]。"*

Another reason for the few Chinese exposures in Vicky's home video-viewing activity was the lack of Chinese video resources. As the mother reported in the second interview, Vicky and her brother liked the movie *Kungfu Panda* a lot and watched several times in English, she said, *"那个找不到中文版的 [(I) could not find that one in*

Chinese version]" (Quote 4.5.19). One of the challenges parents might encounter in supporting the preservation of their children's HL is the scarcity of available resources for that language (Huang & Liao, 2024; Liang & Shin, 2021; Park et al., 2012). The mother reflected on the difficulties to find Chinese touchscreen resources for the children several times during the interviews.

Like the cases of Moe and Tutu discussed previously, the reason behind this could be a lack of technical awareness and knowledge to find proper HL touchscreen resources for the children. Besides this, Vicky's parents were cautious about her touchscreen use; more about Vicky's parental mediations is discussed in 4.5.3.2. The restricted parental attitudes towards Vicky's touchscreen use could also be related to few HL touchscreen exposures, as the parents did not want Vicky to use touchscreen frequently, and they were not keen to find more HL touchscreen resources for Vicky.

However, when looking into the parent-recorded videos of Vicky's video-viewing activity, she only uttered limited words occasionally. For example, see the clip of video 4 (in the first set of parent-recorded videos) below:

> *(Vicky and her brother are watching a gaming video on the iPad together. A gamer is introducing the game while playing it.)*
> *G (Gamer): …And now is time, we defeated the elite four and it is time to go fight the champion.*
> *V: Oh, what's that?*
> *G: So, watch them standing there…*
> *(Quote 4.5.20)*

Just as this clip showed, Vicky did not speak much and she was silent most of the time when watching videos. She watched the videos concentratedly but only spoke one sentence in English. Apart from this, no conversation was found from all the video-viewing activities in the parent-recorded videos. While scholars argue that parent-child interactions during the use of touchscreen devices, particularly with well-designed apps, may promote children's language skills and educational acquisition (Sheehan et al., 2019), the sedentary screen-viewing activity may tell a different story. Studies have found that longer screen-viewing time may be related to a delayed language acquisition of preschool children, as they may miss the chances to fulfil the developmental tasks for language and other vital developments during the screen-viewing activity (McArthur et al., 2022). For Vicky, although she used the touchscreen device to watch videos, oral language was rarely practised during her screen-viewing activity.

Compared with the two activities discussed above, more bilingual language use could be found in the other two activities of the first mediagram, speaking to *Siri* and making video calls with grandparents. These two activities and language use will be discussed in detail in 4.5.3.2.

4.5.3.2 Vicky's second mediagram

Compared to the first mediagram, no new activity was added, and the four original activities and apps were maintained in the second mediagram. The language use of the two activities discussed in 4.5.3.1 did not change. However, the language use in the activity of speaking to *Siri* was amended as more details about this were discussed in the second interview.

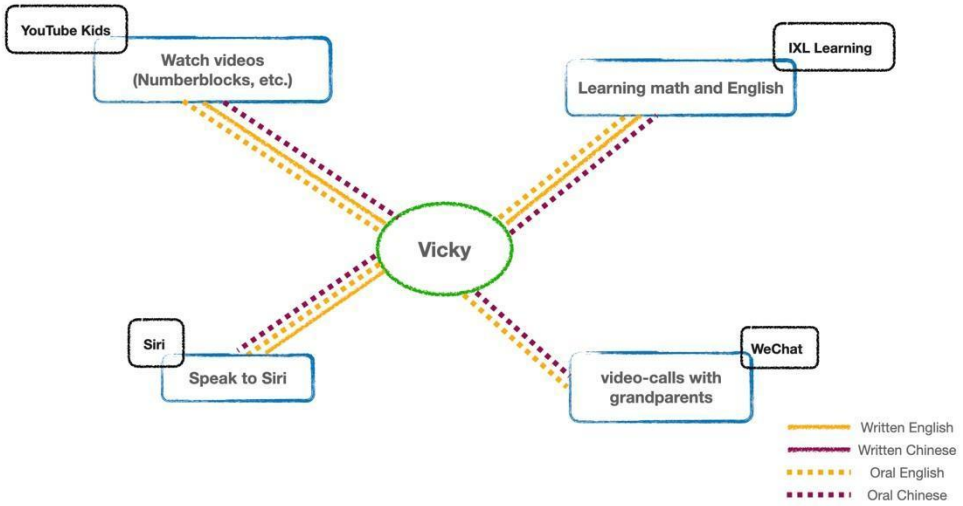

Image 34 Vicky's second mediagram

The activity of talking to *Siri* was mentioned in the first interview as an activity generated by Vicky and her brother due to the restrictive and distant parental mediations (Zaman et al., 2016) of their touchscreen use. The parents monitored not only the time length but also the content of Vicky's touchscreen use; for example, her mother said in the first interview, *"(YouTube Kids)是爸爸给她设置的，然后它里面是可以限时，然后可以屏蔽掉一些成人的一些节目 [(YouTube Kids) is set up for her by her father, and it can set time limit inside, then (it) can block some adult programs]" (Quote 4.5.21)*.

Meanwhile, the parents set rules for Vicky's daily touchscreen use, as her mother said in the second interview, *"要把作业写完才能玩，但最多玩半个小时 [(Vicky) has to finish her homework and then play (iPad), but play for half an hour at the maximum]" (Quote 4.5.22)*.

These PM strategies are common in other studies of children's home touchscreen use as well (Zaman et al., 2016; Nevski & Siibak, 2016). The common reasons mentioned by parents behind parental supervision can be concerns about the child's physical health and addiction issues (Ebbeck et al., 2016; Hinkley & McCann, 2018) . Similar reasons are mentioned by her mother in the first interview, *"我是担心她眼睛 [I worry about her eyesight]。……而且她有时候会上瘾 [And sometimes she can be addictive (to touchscreen use)]。她有时候会说，'妈妈你给我打开吧'，她说，'我脑子里面总是想看，总有个声音告诉我，看 iPad，看 iPad' [Sometimes she says, 'mom, you open (it) for me', she says, 'I always want to watch, there was always a voice in my mind tells me, watch iPad, watch iPad']。我就很担心 [I am so worried]。(Quote 4.5.23)"*

Besides, as the mother said in the first interview, neither Vicky nor her brother knew the password of the iPad, and *"有时候实在我们不让她看东西，然后她又想看，她就跟 Siri 说话 [Sometimes when we really do not let her watch things (on iPad) but she wants to watch, she would talk to Siri.] (Quote 4.5.24)"*

Vicky explained more details of this activity in the second interview, *"妈妈 has to do the password, but when it is locked，我们想看一些 unlocked 的 [Mom has control of the (iPad) password, but when it is locked, and we want to watch something unlocked]…Sometimes 我和哥哥 sneaky sneaky hide somewhere 看一些东西 [Sometimes me and my brother hide somewhere to watch something sneakily]" (Quote 4.5.25).*

Again, the above explanation demonstrated the translanguaging feature of Vicky's language use. Besides this, it also indicated the child's agency in playing touchscreen devices. With limited touchscreen resources and some restrictive PM strategies, Vicky and her brother managed to find a way to increase their touchscreen use and entertain themselves without unlocking the iPad by speaking with *Siri*, a virtual voice assistant. The following conversation clips demonstrate this proximal process of how Vicky interacted with Siri frequently without other people's presence and practise her languages in a bidirectional way (Bronfenbrenner & Morris, 2006).

When we discussed further about the languages she used when talking to *Siri* in the second interview, the following conversation took place:

R：你跟 Siri 说话，说的是英文还是中文啊 [When you speak to Siri, (do you) speak English or Chinese]？

V：中文 [Chinese]！

……

M：那个 Siri 好像听不懂中文我觉得 [I don't think Siri can understand Chinese]。

V：它听懂 [It understands]！

M：它听得懂吗 [Does it understand]？

V：它会给我们弄那些 sound [It can make us some sound]。

(Quote 4.5.26)

Since their iPad system language setting was in English, her mother doubted if the voice assistant could process Chinese. Vicky insisted that she speak Chinese with *Siri*. She illustrated how this worked for us in the second interview, and the following conversation showed a clearer picture of this:

V (Vicky talks to Siri on iPad): Can you do something, talk something in Chinese, Siri?

Siri: In Mandarin Chinese, you can do something, talk something is…

M：哦，那还是英文 [Oh, that is still in English]。

Siri：…你能做点什么吗 [Can you do something]？你能做点什么吗 [Can you do something]？

M：哦，它翻译了 [Oh, it translates]。

(Quote 4.5.27)

Combining the two conversation clips above together, the evidence showed that Vicky did not speak Chinese but English to *Siri*. *Siri* translated the first half of Vicky's question into Chinese (i.e., the double underline is the first half of Vicky's question in English, and the single underlines show how *Siri* translates that part of her question into Chinese). Vicky heard *Siri* speak Chinese, but it was not a proper answer to her

question that was asked in English, but a translation of her question from English to Chinese.

Although both oral Chinese and English appeared when Vicky spoke to *Siri*, English was still the major language she used and was exposed to. As the system setting of her iPad was in English, *Siri* only showed pure English subtitles on the screen from time to time. For example, as illustrated in video 7 (in the second set of parent-recorded videos):

(The iPad is locked; Vicky finds the symbol of Siri on the screen and tappes it.)
Siri: What can I do for you?
V: Show me a picture of mushroom, is under a house.
Siri (shows some pictures on the screen around the corner): Here are the images of mushrooms under a house.
(Quote 4.5.28)

However, if Vicky spoke both Chinese and English in one sentence, *Siri* could not respond properly. As the following clip in video 8 shows:

V: 你可以给我找一个 photo，有一个蘑菇 [Can you find me a photo, with a mushroom] ?
Siri: Is there something else I can help with?
V (Vicky raises up the iPad and says): Don't work.
(Quote 4.5.29)

In Bronfenbrenner's (2006) bioecological model, the developing child plays an active role when interacting with objects independently. From the above examples of Vicky's independent interaction with *Siri*, her agency (Kucirkova, 2019) facilitated her bilingual language practices to different degrees during the turn-taking conversations, and timely responses (Peebles et al., 2018). For instance, *Siri* quickly responded to Vicky's tap of the screen and started the in-turn conversation with her, and if *Siri* could not process Vicky's question, it still quickly responded. In addition, in *Quote 4.5.29* , *Siri* could not process Vicky's question as translanguaging took place while Vicky spoke (see the wavy line). Although *Siri* was designed to understand multiple languages, it may only process one language at a time. As the double-underlines indicated, Siri responded in English, and Vicky replied in English after hearing Siri's feedback. This indicated that *Siri* did not have the linguistic flexibility to fit the needs of a bilingual child, as it could not respond to translanguaging sentences, and this design may lead to forcing the child into monolingual practices when using *Siri*. This could also potentially influence the bilingual child's unique linguistic repertoire by forcing them to think and speak with a monolingual mindset.

Due to the limited types of touchscreen resources and activities, Vicky liked this activity throughout the interviews. When I asked her if she still liked speaking to *Siri* in the third interview, she said, *"嗯，喜欢，因为我们可以看东西 [Yes, (I) like (it), because we can watch things]。"(Quote 4.5.30)*

Similar to Siri, the growing popularity of digital voice assistants (DVAs) (Festerling & Siraj, 2022) like *Google Home* and *Alexa* has enabled children to engage with internet-based devices and access online information more easily (Tong et al., 2022). However, research in this field is rather limited, and the nature of the communication between the children and the DVAs is worth studying (Tong et al., 2022). In this activity, Vicky needed to speak and communicate with Siri in fluent and clear monolingual language to get something she wanted to watch. It motivates her to practise her oral English

more. However, as discussed above, this monolingual language practice may have potential harms to her unique bilingual repertoire and may eventually cause her to think with a monolingual mindset to some extent.

Image 35 Vicky speaking to Siri

Different from this activity, when making video calls with her grandparents via *WeChat*, Vicky preferred to speak more Chinese than English. When asking if Vicky used English when making a videocall with her grandmother in the first interview, she said, "姥姥不知道怎么说 *[Grandma does not know how to speak (English)]" (Quote 4.5.31)*. This answer again indicated that she could distinguish the two languages, and she knew that her grandmother spoke Chinese instead of English.

And her mother added more about her language use during the videocall activity:

"她有的时候一激动就会说英文 [She sometimes speaks English when she gets excited]。… 或者就混着说 [Or mix (the two languages) to speak]。比如，她说，'姥姥，我买了一个 dress' [For example, she said, 'Grandma, I bought a dress']！姥姥说，'什么是 dress，听不懂' [Her grandma said, 'what is dress, (I) don't understand']。然后她还得问我，'妈妈，这是什么意思' [Then she has to ask me, 'Mama, what does this mean'] ?"(Quote 4.5.32)

From the above data, Vicky mainly spoke Chinese when communicating with her grandmother; however, the use of English vocabularies from time to time also appeared. As the example showed above, her mother needed to act as a bridge to translate the English word into Chinese to support the communication between Vicky and her grandmother. Although Vicky preferred to use the language that her grandmother understood, her language choice can be influenced by her different language capacities (e.g., vocabulary) of the two languages. This pattern of Vicky's language use during this touchscreen activity is maintained throughout the data collection. As a young bilingual, Vicky demonstrated her translanguaging skills, using her unified linguistic repertoire to develop her bilingual capacities (Wei, 2018). She might speak English in which she was more fluent and confident, either unconsciously or when she only knew how to explain things in English. Meanwhile, parents' assistance in this activity was also vital, as sometimes the communication between her and her grandparents needed her parents' translation and explanation.

4.5.3.3 Vicky's third mediagram

Looking into the three mediagrams, most of Vicky's language exposure was in English, and oral English was used in all her touchscreen activities. Compared to the English exposure, Chinese was less used in these activities; no written Chinese was found in any touchscreen time. Compared to the former two mediagrams, two more activities were added to the third mediagram, and the four activities that were discussed previously and the related language use were rather stable.

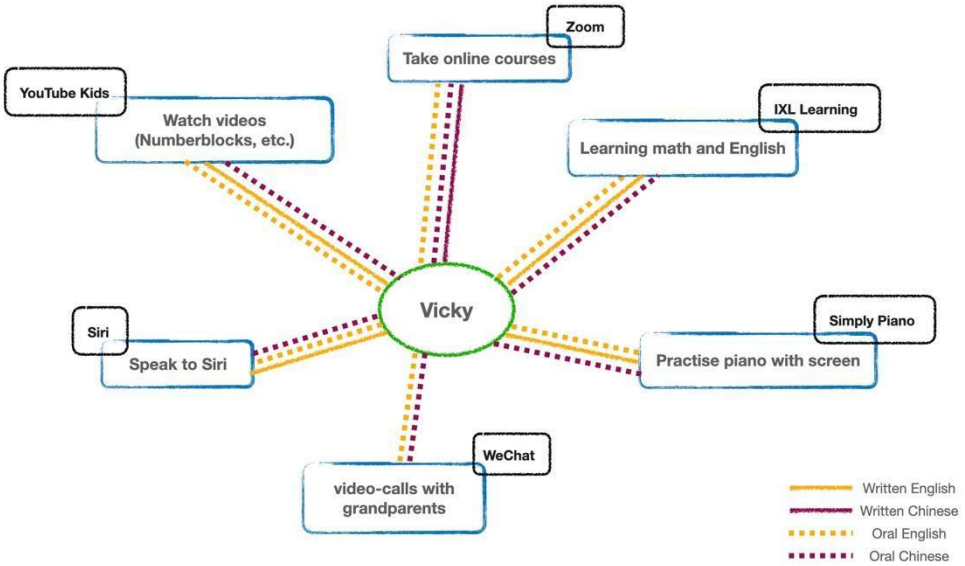

Image 36 Vicky's third mediagram

For the two new touchscreen activities, by the time of the third interview, Vicky had

begun to take a new online class to learn traditional Chinese culture. The new Chinese lessons were held online since the children are located in different countries, such as the UK, France, and Germany. Therefore, as Vicky's mother said, the children all mixed different languages they could speak during the classes, but the teacher spoke in only Chinese. As her mother further explained about the multi-language use in the third interview, *"老师有时候说，'我听不懂' [Sometimes the teacher says, 'I don't understand (what you say)']。有时候妈妈或者爸爸在旁边的就解释一下，就是这样 [Then sometimes the mother or father who is next to (the children) would explain (to the teacher), like this]。" (Quote 4.5.33)*

For Vicky, when attending this new lesson with her iPad via *Zoom* every week, she used both Chinese and English in this class, and parental support of explaining and translating the child's expression to the teacher was also vital for the class delivery quality. Like the videocall time with her grandparents, when talking to Chinese monolingual people, parental language support and companionship were vital for Vicky.

Second, by the time of the third interview, another new app called *Simply Piano* had been introduced to Vicky's family. According to her mother, Vicky and her brother used this new app to practise their piano skills daily. As her brother explained, to play with this app, *"你必须要用你的钢琴 [You must use your piano]" (Quote 4.5.34)*. Vicky and her brother used this app as a digital piano music library to mainly practise their physical piano skills. Therefore, this app functioned more as an educational app than an entertaining app. As this app contained many English songs and instructions, written English was added for this activity. Besides this, like other co-use activities of Vicky and her brother, both oral English and Chinese were added for this activity as well.

While her English was developed gradually since she went to school and learnt about English in a systematic way in school, Vicky's Chinese was also developing at the same time. Through going to a Chinese community school since the time of the second interview, Vicky's Chinese skills developed as she could speak more fluent and complete Chinese sentences in the third interview and developed her Chinese reading skills to some extent. She read several Chinese poems fluently and voluntarily to me during the third interview.

For example, she could read a traditional poem without any fault fluently. In the third interview, Vicky read a poem when looking at her Chinese textbook: *"我知道这个 [I know this one]！ 鹅鹅鹅，曲项向天歌 [Goose, Goose, Goose, you crane your neck to the sky, sing]。白毛浮绿水，红掌拨清波 [White feathers float on water green, red webbed-feet paddle through waves clean]。" (Quote 4.5.35)*

Although the language development of Vicky could be influenced by several factors, attending online and offline Chinese classes could be vital for her oral and reading skills development in Chinese. Compared to the development of English, Vicky developed her Chinese more in a traditional, non-digital way instead of using some touchscreen resources. During Vicky's touchscreen time, compared to the amount of English exposure, limited Chinese resources were found or used.

4.5.4 Summary

As a five-year-old bilingual girl, Vicky spoke both Chinese and English in her daily life. Although she did not explain her understandings of the two languages clearly in the LP activity, she did gradually develop her knowledge about languages and distinguish the two languages through the following interviews. In Vicky's daily family life, her FLP was rather stable; she used both Chinese and English to communicate. The parents did not set strict rules for their children's language use at home. While she mainly spoke Chinese with her parents and grandparents, Vicky also communicated in English with her brother. Meanwhile, translanguaging (Wei, 2018) was one main feature of Vicky's language practice. She often mixed the two languages into one sentence during her daily communication. When talking to somebody who was Chinese monolingual, such as her grandmother or the online Chinese class teacher, parental support and translation were sometimes necessary to facilitate the fluent communication between Vicky and the monolingual people. Although Vicky spent much time at school in English, she showed clear interests in developing her HL, as she asked to go to the CI Chinese school herself and attended another Chinese class related to traditional Chinese culture.

Overall, when looking into Vicky's family's touchscreen use, many restricted PM strategies emerged since the parents were worried about potential risks of physical harm to eyesight and addiction issues. Apps with educational functions were encouraged to be used compared to others, such as for studying maths/English and practising piano. Most of the apps that Vicky used were designed in English, and the videos that she watched were also mainly in English. The mother reported a lack of touchscreen resources in Chinese, which may be related to the levels of parental digital knowledge of finding Chinese resources, or their attitudes and restricted PM strategies of Vicky's touchscreen use. Within limited touchscreen resources, Vicky and her brother found the activity of speaking to *Siri* themselves, as Vicky wanted extra touchscreen time but did not know the password. This activity also facilitated her oral language practice of speaking complete sentences in only one language, since the voice assistant could only process her instructions when she spoke grammatically correct monolingual sentences. However, this activity could also have potential harm to the wholeness of her bilingual repertoire since she might need to think and speak with a monolingual mindset during this activity. Moreover, the co-use behaviour with her brother was common in most of her touchscreen activities. And her elder brother's language choice could influence her touchscreen use and language choice during these activities and daily communication as well.

Apart from these touchscreen activities discussed above, Vicky also developed her bilingual capacities in varied non-digital ways. As Vicky began school, she started to spend more time on her English learning in a systematic way, such as learning phonetics by making sentences in school. Meanwhile, although Vicky had limited exposure to the touchscreen resources in her HL throughout the data collection, her interests in maintaining this language and her oral and reading skills in Chinese were developed with the help of the Chinese classes and other family activities.

4.6 Wangwang's case study

4.6.1 Introducing Wangwang's case

Wangwang was a four-year-old boy who was born and raised in middle England, and he lived with his parents. His mother was Chinese, and his father was Malaysian. Wangwang was exposed to mainly Chinese (Mandarin and some Chinese dialects, such as Hakka, vernacular (or Baihua), and Cantonese) and English in his daily life. By the time of the first interview, Wangwang had just begun his reception year. By the

time of the second interview, Wangwang had started attending a weekend Chinese class. By the time of the third interview, Wangwang was in the middle of his winter holiday, and his grandmother had come to visit him from China. The family was approached through the network of a heritage language school. Emails were sent to parents associated with this HL school, and Wangwang's mother expressed her interest in participating in my study. The informational letter was sent to his mother, and a short phone call was conducted to provide more details about the research. Then, the parent sent me her signed consent, and Wangwang gave his oral assent both before and throughout the interviews.

The total length of the three family interviews that were conducted with Wangwang's family was about 5 hours. All the interviews were held with Wangwang and his mother. Wangwang's father was busy with his work and travelled a lot during the time of the data collection; he spent limited time at home during this period. The second interview was conducted two months after the first interview, and the third interview was held one and a half months after the second interview. During the intervals of the three interviews, two sets of parent-recorded videos were sent to me (4 video clips, 6 minutes in total). Three evolving mediagrams of Wangwang's touchscreen activities and language use were drawn and edited after holding each interview with the family.

4.6.2 Wangwang's language choice

In Wangwang's case, English and Chinese (Mandarin) were the two languages that he used every day. However, his actual language practices could be influenced by many factors, such as parental language habits and different social contexts. The details of Wangwang's language choice will be discussed in the following sections.

4.6.2.1 Language portrait (LP)

The language portrait (LP) activity was conducted with Wangwang and his mother during the first interview. Before starting to draw the LP picture, Wangwang demonstrated that he was not familiar with the terms of the two languages he could speak. When choosing colours for the two languages, his mother used different contexts to help him understand the two languages, as the following conversation showed:

> *M (Wangwang's mother)：那你选什么颜色，在学校里面（说的语言）[So what colour do you pick, (for the language you) speak at school]？*
>
> *W (Wangwang)：蓝的 [Blue]。*
>
> *M：蓝的，好 [Blue, ok]。*
>
> *M：在家里面（说的语言），什么颜色 [(The language you speak) at home, which colour]？*
>
> *W：红的 [Red]。*
>
> *M：红的，好 [Red, ok]。蓝色的是学校的，红的是家里的 [Blue is for (the language you speak) in school, red is for (the language you speak) at home]。*
>
> *(Quote 4.6.1)*

During the LP drawing process, Wangwang showed clear preference on the colour that he wanted to draw. He quickly painted the whole body of the image in red but did not paint in blue. As his mother asked him where he wanted to paint in blue, Wangwang simply shook his head, and then he painted more in red. Therefore, as the following

LP picture showed, Wangwang painted a little in blue and mostly in red. However, this colour preference might not equal his language preference, since he was too young to give explanations for why he painted like this. Research indicates that involving children in exercise-orientated LP activities can generate more enthusiasm and decrease stress compared to conventional interview techniques (Tatham-Fashanu, 2021). For this four-year-old boy, this LP activity mainly acted as an ice-breaking activity to help him reflect more on his language use. More details about Wangwang's language choices will be analysed below.

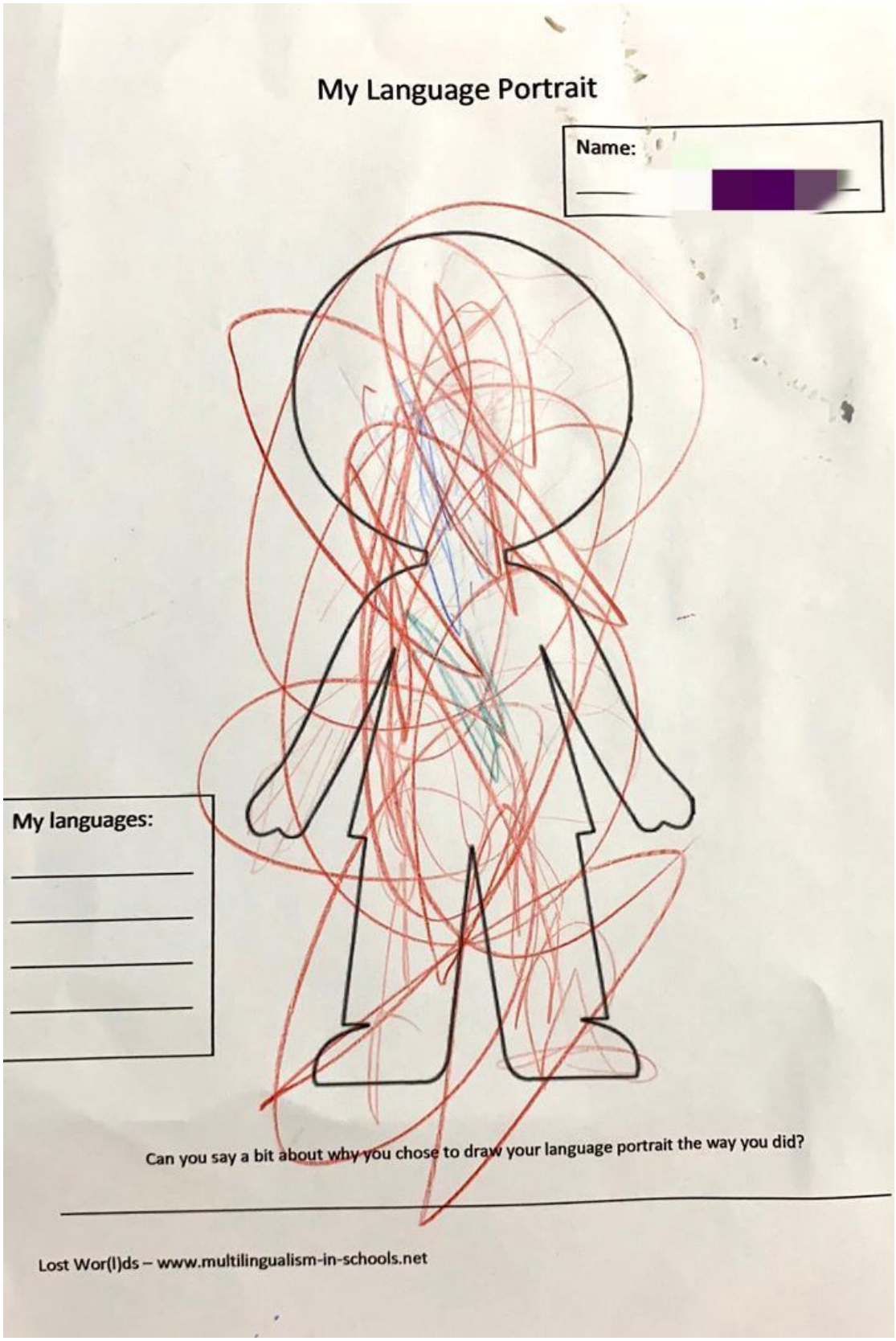

Image 37 Wangwang's language portrait

4.6.2.2 Family language policy (FLP)

Throughout the data collection, Wangwang's family language policy (FLP) (Wilson, 2020) was flexible and had some special features. First, as stated previously, Chinese

is the main language that the parents used to communicate with Wangwang. As his father was Malaysian, he spoke not only Mandarin Chinese but also three Chinese dialects. So Wangwang was also exposed to these Chinese dialects sometimes, at least some accents of the Chinese dialects that his father spoke. As his mother said in the first interview, *"客家话，白话，粤语，是他最主要的三门语言，所以说他在说中文的时候呢，会有一些口音在里面 [Hakka, vernacular (or Baihua), and Cantonese are his (Wangwang's father) three primary languages; therefore, when he speaks Mandarin Chinese, there will be some accent present]。(Quote 4.6.2)"*

Moreover, as Wangwang's grandparents from Malaysia spoke some Chinese dialects when facetiming with Wangwang, the additional accents or dialects complicated Wangwang's language exposures. As a vital part of the microsystem (Bronfenbrenner, 1979), parents may have a substantial and direct influence on preschool children's multiple developments (Harrison & McTavish, 2018). As Wangwang's mother could only speak Mandarin Chinese and English, and she could not understand other Chinese dialects that Wangwang's father and his parental relatives spoke, the father tried to use mainly Mandarin Chinese when communicating with her mother at home, sometimes with dialect accents, according to the mother's further explanation.

As stated in the introduction part, Wangwang's father was busy with work and travel, and he spent limited time at home during the data collection period. The mother also mentioned in the first interview that it was mainly Wangwang's father who accompanied and took care of Wangwang for about two years since he was born. She believed that Wangwang's father's language habits could deeply influence Wangwang's language use, especially his oral language skills. As Wangwang's mother said in the second interview, *"爸爸对他影响很大的，他现在说话的所有的尾音，是他爸爸的尾音，一模一样 [His father has had a significant influence on him (Wangwang); the tones of his speaking, especially the ending tones of his utterances, are exactly like his father's]。(Quote 4.6.3)"*

During the whole data collection, Wangwang's oral expressions in both English and Chinese had some specific accents. For example, when Wangwang was demonstrating how he played with an English audiobook in the first interview, the following conversation happened:

B (Background voice of the audio book): … into a delicious chocolate cake!
*W: **DON-CO-LA** (Chocolate) cake? Hahaha.*
M: Chocolate cake.
(Quote 4.6.4)

In this example, the underlined part showed that Wangwang mispronounced the English word *'chocolate'*. He pronounced three similar syllables to imitate the pronunciation of the background voice. However, he pronounced the English word *'cake'* clearly. Another similar example was when we were discussing his favourite cartoon, *Police Lego,* in the second interview:

M：那还发生什么事情了吗 [Did anything else happen (in a cartoon video)]？

*W：那里面没东 **YI** (i.e., 西, pronounced as /xī/ in Mandarin）[There was nothing inside]。他只是在 **DUO** (i,e., 说, pronounced as /shuō/ in Mandarin）话 [He was just talking]。*

M：没有东西在说话 [Nothing was talking]？

W：没有玩 JI（具，pronounced as /jù/ in Mandarin）在那里 [No toy is there]。
(Quote 4.6.5)

In this example, the underlined words demonstrated that Wangwang sometimes spoke Chinese with accents. The accents are highlighted in **bold,** and more about this will be discussed in section 4.6.3 while discussing Wangwang's touchscreen use and language practices.

However, although the mother believed that Wangwang's oral accents were influenced by his father's language habits and the complicated family language environment, the examples of Wangwang's oral accents during the data collection did not necessarily relate to the pronunciations of the Chinese dialects that he was exposed to.

For all the examples of Wangwang's accents demonstrated in this case study, besides listing the correct Mandarin pronunciations, I double checked the pronunciations in the three Chinese dialects and Malay for these words through online pronunciation tools. None of Wangwang's pronunciation accents were directly related to any of these languages. Therefore, Wangwang's pronunciations could be at a developmental stage, and the assumed dialect accents mentioned by his mother might only be the immature child language pronunciations at a young age.

Wangwang's mispronunciation of some words in Chinese and English, sometimes made it difficult to clearly understand what he was talking about. This feature of Wangwang's oral language led to another language management strategy mentioned by the mother. She was aware of his mispronunciation and tried to correct him in daily life. As his mother stated in the third interview,

"中文的话，我会去纠正他的发音，因为他的发音好多就是不准的 [If (he speaks) in Chinese, I would correct his pronunciation because many of his pronunciations are inaccurate]。他的舌头很懒，他只会选择自己觉得方便的发音，所以他的发音很不准 [His tongue is lazy, and he only choose to pronounce in a way that he finds convenient, so his pronunciation is very inaccurate]。我就在一直一直的纠正他 [I just keep correcting him over and over again]。"(Quote 4.6.6)

The correction of Wangwang's pronunciation also appeared several times during the family interview. One example in the third interview was listed below:

*W: Spider-Man **DA** (i.e., car in English)!*
M: Spider-Man car. 车，蜘蛛侠的车 [(The mother pronounced in Mandarin) Car, Spider-Man's car]。
*W：蜘蛛侠的 **DE** (车 [Car], pronounced as /chē/ in Mandarin)。*
(Quote 4.6.7)

In this example, the underlined sentence showed Wangwang's mispronunciation of the word *'car'* in both English (double-underline) and Chinese (underline). He substituted the /d/ sound for /c/ when speaking the English word *'car'*. His mother tried to correct his English pronunciation first and then translated the sentence into Chinese (see the wavy line). Wangwang imitated and repeated his mother's words in Chinese, he pronounced all the other Chinese characters correctly except the word '*车 (/chē/)*', he substituted the /d/ sound for the /ch/ sound here. Looking into several examples of Wangwang's accents, /d/ was a frequently used onset that Wangwang mispronounced

words in both languages. But I checked the dialect pronunciations that Wangwang could be exposed to; this unique pronunciation was not part of any of these languages that he was exposed to.

Besides this, another feature of Wangwang's language choice was the quick development of English. As his mother stated in the first interview: *"上了全日制，就是五天的幼儿园以后，他的英文就进步得很快 [(After he) went to full-time nursery, which is five days (per week), his English has been improving very quickly]。(Quote 4.6.8)"*

The beginning of school can be a vital time point for bilingual children's language shift, as they may reduce their use of HL to perform better at school in the dominant language, English (Little, 2019; Stewart, 2017). Like in the cases of Vicky and Tutu, this change of Time and Context influences several proximal processes and Wangwang's bilingual development (Bronfenbrenner & Morris, 2006). Being exposed to an English school environment five days a week, Wangwang regularly and frequently interacted with his teachers and classmates in English, and these interactions facilitated his English development.

Apart from the change of Time and Context, the characteristics of Wangwang's parents significantly influenced his bilingual language practices in his most immediate environment as well. The following discussions about their FLP indicate the vital influence of his parents. After starting school, Wangwang's parents sometimes adjusted their language preference when talking with Wangwang (resources) to meet different social or educational needs and expectations (forces). As Wangwang started his reception year by the time of the first interview, his mother mentioned that she also spoke English with Wangwang in some specific scenarios. As she mentioned in the first interview,

> *"比如说在学校里面你如果遇到什么事情了，你该如何去跟别人回应的时候，然后你该怎么说的时候，我会说英文，给他建一个体系 [For instance, if you (Wangwang) encounter(s) something at school and need to know how to respond or what to say to others, I would explain (school-related things) in English and build a system for him]。但是一般的沟通，平时的沟通的话都是中文 [But for daily communication, we usually speak in Chinese]。(Quote 4.6.9)"*

Similarly, Wangwang used mainly English to study maths and some coding classes at home, as his parents believed learning this knowledge in English could benefit his further study in school. Taking Wangwang's use of a maths app called *To Do Maths* as an example, Wangwang's mother explained their language ideology and management strategy in the first interview:

> *"他爸爸说，'你现在教他中文去读题去理解，那么到了学校了之后，他可能会做这道题，但是他不知道怎么去用英语解释或者听不懂什么意思' [His father said, 'now you teach him to read and understand the questions in Chinese, then when he goes to school, he may be able to solve the questions, but he doesn't know how to explain them or understand the meaning (of questions) in English]。……的确，然后我就把 To Do Maths 就变成英文的了 [Indeed, so I changed the To Do Maths into the English version]。(Quote 4.6.10)"*

These social and educational needs influenced the parental language management in

Wangwang's family. As shown in the example above, Wangwang's father worried about his school performance if he developed subjects like maths in Chinese instead of English, as the school education requirement was to develop and learn the knowledge in English. So, they altered their FLP and let Wangwang immerse himself in English content instead of using Chinese resources while studying subjects like maths. Although Chinese was still the main language that the parents spoke at home, Wangwang spent more time practising and improving his English skills after starting school. When we were discussing one of Wangwang's favourite toys in the third interview, the following conversation happened:

M：Play Mobile 你喜欢玩什么 [What do you like to play most in Play Mobile]？

W: Fire truck!

M: 哦，'fire truck'中文是什么 [Oh, what is 'fire truck' in Chinese]？

W：我也不知道，我知道 English [I don't know, I know (it in) English]。

M：消防车 [Fire truck (the mother pronounced 'fire truck' as /xiāofángchē/ in Mandarin Chinese)], 'fire truck' 是消防车['Fire truck' is (pronounced as) /xiāofángchē/]。

W：Hmm-hmm-hmm.

M：读，消防车 [Read, /xiāo fáng chē/]。

W：Fire truck! Ha-ha.

M：那 'fireman'你知道是什么吗 [And do you know how to say 'fireman' (in Chinese)]？

W: Fireman!

M: 'Fireman'是消防员 ['Fireman' is (pronounced as) /xiāo fáng yuán/]。

W: Fireman. 我知道 English，我不知道中文 [I know (the word in) English, I don't know (it in) Chinese]。

(Quote 4.6.11)

In this example, Wangwang only knew some vocabulary related to his favourite toy in English instead of in Chinese. However, this language use did not necessarily mean that his English capacity was better than his Chinese capacity. This example also showed that Wangwang's understanding of the two languages kept growing. He could clearly tell the two terms of the languages, English and Chinese (as the double underline shows), by the time of the third interview, but he did not distinguish the two languages clearly in the first interview.

While the above FLP acknowledged the importance of developing English skills to meet Wangwang's educational needs, his parents also showed positive attitudes in the maintenance of Chinese (forces) (Chinese was used to represent Mandarin Chinese in the following discussion about Wangwang's HL, to match the terms in other cases). For example, the mother mentioned in the second interview that she sent Wangwang to weekend Chinese class and accompanied him to finish Chinese homework after class. Besides, when Wangwang's grandmother came to visit them from China, the mother expressed more about her positive attitude and FLP towards Wangwang's Chinese maintenance:

"他说英文的时候，我会中文的再给他翻译一遍 [When he speaks in English, I will translate it into Chinese for him]。比如他说 'fire truck'，我就说'消防车'，他说'fire

man'，我就说'消防员' [For example, when he says 'fire truck', I'll say '/xiāofángchē/' (i.e., fire truck in Chinese), and when he says 'fireman', I'll say '/xiāo fáng yuán/' (i.e., firefighter in Chinese)]。……我的最终目的就是一定要学会中文去说 [My ultimate aim (for this language use) is to make sure he learns to speak (things) in Chinese]。姥姥还在家呢，我说，'你必须要说中文，你不说中文姥姥听不懂' [Grandma is at home, and I tell him, ' you must speak Chinese because if you do not speak Chinese, grandma cannot understand']。" (Quote 4.6.12)

In the above narration, the mother mentioned the importance of speaking Chinese to communicate with Wangwang's maternal grandmother since she could only speak Chinese. HLs can reinforce family bonds and enhance recognition of one's cultural roots and identity (Chen et al., 2021; Wang, 2023). Their FLP also stressed helping Wangwang learn to speak fluent Chinese to maintain family bonds and communicational needs across generations. To achieve this goal, several strategies were applied. As mentioned in the above narration, the mother would translate the English words or sentences that Wangwang knew into Chinese and let him learn to speak these words in Chinese gradually.

Besides the FLP and Wangwang's language choice mentioned above, translanguaging (Wei, 2018) also appeared in Wangwang's language use from time to time. For example, in the first interview, when picking colours for the LP activity, Wangwang said, *"I want 三个笔 [I want three pens] (Quote 4.6.13)"* Similarly, when he introduced his rocket model in the third interview, he said, *"又一个[Another] astronaut! Space! (Quote 4.6.14)"* In the two examples, Wangwang used English words and Chinese words together in one sentence, as he might only know the vocabulary in one language and need to use his whole linguistic repertoire to express himself.

However, while translangugaing took place from time to time, during most of the time, Wangwang spoke in either complete English or Chinese, although with some child accents and mispronunciations. For instance, when he recalled his favourite festival in the first interview, he said, *"I don't have Easter. 我* ***DON*** *(i.e., '生', pronounced as /shēng/ in Mandarin）病 [I was ill]！(Quote 4.6.15)"* In this example, Wangwang spoke two complete sentences in English and Chinese separately. He pronounced the English sentence correctly, but he mispronounced the first character of a Chinese word, which means getting ill, in the second Chinese sentence (see the underlined sentence).

4.6.3 Evolving mediagrams

In this section, more about Wangwang's bilingual development during his home touchscreen activities will be discussed. The three mediagrams illustrating Wangwang's exposure of languages during his touchscreen activities were developed in an evolving way as in other cases.

4.6.3.1 Wangwang's first mediagram

The first mediagram captured five of Wangwang's home touchscreen activities, and several varied apps were used during these activities. The exposure and use of oral language was one main feature of Wangwang's touchscreen time, both oral English and Chinese were used in four activities. The exposure of written English was seen in

two activities: playing educational apps and watching videos. While written Chinese was only used when he took an online music course.

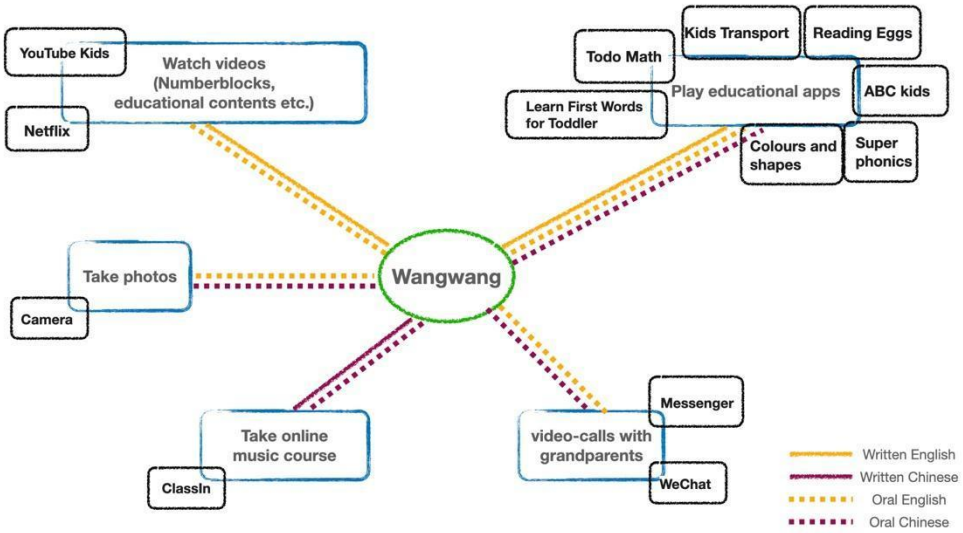

Image 38 Wangwang's first mediagram

Among all these activities, according to his mother's reflection in the first interview, playing educational apps, watching videos, and taking online music courses were the three most frequent activities for Wangwang. The online music course took place in a complete Chinese environment via *ClassIn*. He had been taking this lesson for over ten months by the time of the first interview, and he learnt Chinese songs with a Chinese-monolingual music teacher online twice a week, 30 minutes each time. As his mother explained in the first interview, *"他在学音乐的时候是在线上和中文老师一起学中文的歌曲，就唱歌 [He learnt Chinese songs with a Chinese teacher when he was studying music online; he just sang]。(Quote 4.6.16)"*

Through the processes of learning some Chinese songs online, Wangwang developed not only his Chinese listening and speaking skills but also his reading skills. He sang the Chinese songs and read the Chinese lyrics with the help of his mother after class. As the example that his mother illustrated in the first interview,

> *"比如说遇到他特别喜欢的音乐，他就会一直在唱，他唱的时候我就拿谱子出来 [For example, when he encounters music he particularly likes, he would keep singing it; when he sings, I would take out the sheet music (with Chinese lyrics on it)]。然后他边唱我遍指字 [Then, as he sings, I would point to the lyrics]。然后他唱了几遍了我指了几遍了，他说，'妈妈，这是猫！'我说，'对了' [After he sang it a few times and I pointed it out a few times, he said, 'Mom, this is a cat!' I replied, 'That's right.'] 。他有时候猫和狗分不清，但他知道有个反犬旁 [Sometimes he can't distinguish (the Chinese characters of) cat and dog, but he knows there is a meaning clue for dog (in the character) (i.e. the meaning clue in the two Chinese characters that means cat and dog are same)]。(Quote 4.6.17)"*

From this example, Wangwang practised the Chinese songs he learnt while looking at the corresponding Chinese characters in the lyrics that his mother pointed to one by

one. During this process, although he did not recognise many Chinese characters, he could memorise some features of certain Chinese characters and develop his sense of Chinese characters, such as the meaning clue for the Chinese characters of dog and cat. Besides, as his online music teacher is Chinese monolingual, only Chinese was used and practised during the online music lessons, according to the mother's observation.

In terms of the activity of watching videos on *YouTube Kids* and *Netflix*, English became the main language used during his touchscreen-viewing time. As his mother explained in the first interview, *"中文的话，因为 YouTube 上它没有特别多的中文动画片 [In terms of Chinese (content), there are not many Chinese cartoons on YouTube]。还有 Netflix 上面也没有中文动画片 [And there are not Chinese cartoons on Netflix either]。那我们想看中文动画片是没有资源的 [So, we do not have access to resources if we want to watch Chinese cartoons]。(Quote 4.6.18)"*

The mother pointed out that the Chinese resources on these video apps were limited. As reported in some other case studies in my study and some other studies, parents could find it difficult to find proper Chinese inputs for their children within limited resources (Huang & Liao, 2024; Liang & Shin, 2021). However, as discussed in previous cases, the lack of HL touchscreen resources could also be related to the lack of technical awareness or skills to find proper HL contents for their children.

Besides this, throughout the interviews, the mother also demonstrated varied parental mediation (PM) strategies (Zaman et al., 2016) on several aspects of Wangwang's video-watching, such as the length and contents. For example, the mother mentioned one restrictive PM in the first interview, *"他平时看电视的时间只有周六日两天，星期一到星期五不怎么看 [He usually watches television only on Saturdays and Sundays and doesn't watch much from Monday to Friday]。……平时是不可以看的，只能是拿平板做练习，用平板去学习 [He is usually not allowed to watch television; he can only use the touchscreen for exercises and learning]。(Quote 4.6.19)"* More about the PM strategies will be analysed in section 4.6.3.2.

According to the above rule of using a touchscreen, playing with educational apps was the main activity that Wangwang could do on his iPad during the weekdays. As it was shown in the first mediagram, most of the apps were educational in nature. Throughout the data collection, the touchscreen was mainly used as a learning tool instead of an entertaining device for Wangwang. The patterns of a child's touchscreen adoption can be largely affected by parental attitude and mediation (Kumpulainen & Gillen, 2019; Mendoza, 2009). As his mother said in the third interview, *"在我们的家庭生活里，除了学习之外，iPad 我们一直在弱化这个东西 [In our family life, apart from studying, we have been trying to use the iPad as little as possible]。(Quote 4.6.20)"*

Besides, all these educational apps were downloaded in English, therefore, both oral and written English appeared during the use of these apps. Oral Chinese was also used, since his mother spoke Chinese to communicate with Wangwang while using these educational apps. As mentioned in section 4.6.2, Wangwang's mother mostly communicated with Wangwang in Chinese, and her language choice was the same pattern during Wangwang's touchscreen use. The following example from the first set

of parent-recorded videos could give a hint on how they communicated while playing Wangwang's favourite touchscreen app, *Todo Maths*:

(Wangwang is playing Todo Maths on his iPad. He looks at the subtitles on the screen.)
B (Background voice): Tally hides at the place of eight.
(Wangwang uses his right-hand index finger to count on the screen.)
W (He points at the screen and looks at his mother.): That's eight?
M: 你自己想 [Think on your own]。
W: No? Eight?
M：自己想 [Think on your own]。
W (Wangwang uses his right-hand index finger to press and operate the animation on the screen and hit the right target, and there is a reward sound and animation effect): Yeah! Great, that one!
(Quote 4.6.21)

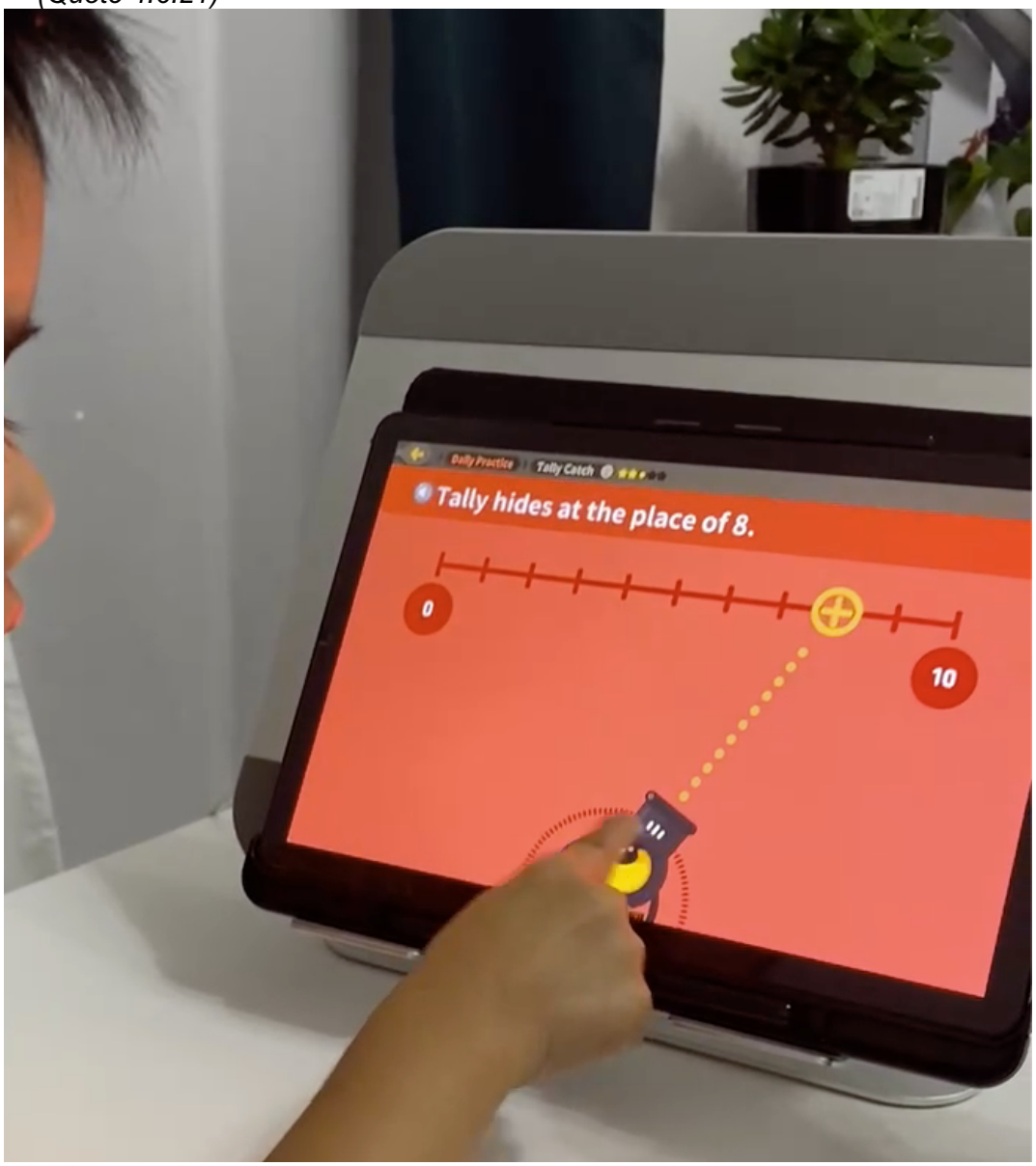

Image 39 Wangwang playing Todo Maths

In the microsystem, parents often actively mediate their children's maintenance of the societal minority language through parent-child interactions (MacLeod et al., 2024). In

this example, while engaging with the responsive touchscreen, parent-child bidirectional interactions also indicate how Wangwang practised languages during the interactions with his mother (MacLeod et al., 2024). Wangwang's mother replied to Wangwang in Chinese (see the underlines), while Wangwang talked in complete English (see double-underlines). This language use in this example matched Wangwang's mother's narration in the second interview, *"他是用英文的 apps [He used all apps in English]。然后他在跟我说的时候呢也是拿英文，但是我都是拿中文来回答他 [Then he talked to me in English as well (while using the apps), but I always replied to him in Chinese]。(Quote 4.6.22)"*

Similar examples as above were shown several times through the data collection (e.g., see *Quote 4.6.31*). However, apart from speaking English, translanguaging (Charamba, 2020) also appeared in the parent-recorded video, Wangwang used both English and Chinese in one sentence occasionally (see the wave lines). As the following example showed:

> *W (Wangwang uses his right-hand index finger to operate the animation on the screen and does not hit the correct target.): Now 我们要打* ***D-EI*** *(i.e., '这个', pronounced as /zhè ge/ in Mandarin) [Now we are going to hit this one]!*
> *W (Wangwang changes his target, and this time shots the correct target and there is a reward sound and animation effect.) Hahaha. Or 打 that one [Or shoot that one]!*
> *(Quote 4.6.23)*

Meanwhile, in the second set of parent-recorded videos, Wangwang also spoke complete Chinese sentences to his mother while using the app *Baby Piano* (see example in section 4.6.3.2). Therefore, although speaking English was one typical feature during Wangwang's engagement with these English educational apps, his language utterance was in a fluid and changeable state (Wei & García, 2022). Wangwang's translanguaging practices demonstrated the influence of his characteristics (forces, resources) on his bilingual development (Bronfenbrenner & Morris, 2006). He demonstrated his unique bilingual linguistic repertoire (García & Otheguy, 2020) during his touchscreen engagement, just as in his other daily activities. His motivation of practising both languages (forces) can also be seen as prompts for his translanguaging practices, and his agency actively influenced the actual language use during this touchscreen activity (Shen & Jiang, 2023). Meanwhile, in this example, while engaging with the responsive touchscreen apps that can provide immediate feedback (Kucirkova, 2019), Wangwang's practised his agency through independent operation and decision-making processes while playing this maths app (Peebles et al., 2018; Russo-Johnson et al., 2017).

4.6.3.2 Wangwang's second mediagram

In the second mediagram, Wangwang's touchscreen activities did not change much, excluding the activity of taking photos, which no longer addressed his interest. Although the types of activities did not change much, the languages and apps used in two activities were adapted after further discussion of the activities.

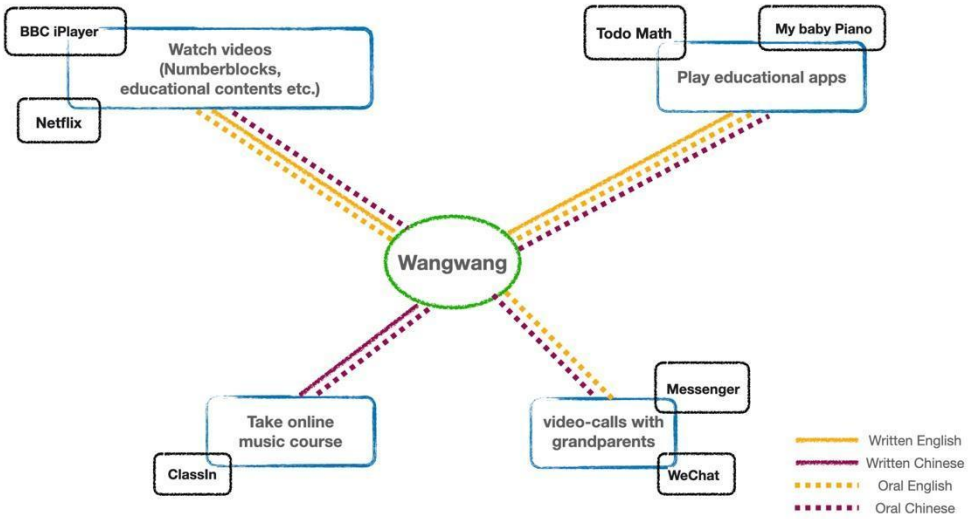

Image 40 Wangwang's second mediagram

As mentioned before, Wangwang mainly watched videos in English during his screen time, oral and written English appeared while he watched videos such as *Numberblocks*. Moreover, as his mother recalled in the second interview, intensive parent-child interactions were interwoven into Wangwang's video-viewing time.

> *"他就会一直说，'妈妈你看这有一个马这有一个什么车'，他会一直给我描述 [He would keep saying, 'Mom, look, there is a horse, there is a certain car', he would keep describing (things) to me]。他会跟我说，我也会跟他说 [He talks to me, and I would respond to him]。我说，'哎呀这是什么呀' [I would say, (for example) 'Oh, what is this'] ？'怎么这么奇怪啊' ['Why is it so strange'] ？…对，我们一直在去说 [Yes, we keep talking]。"(Quote 4.6.24)*

Similarly, in the third interview, the mother mentioned that *"因为卡通就是我们谈话的语料库，我们的素材库 [Because cartoons are the corpus of our conversation, our material library]。(Quote 4.6.25)"*

However, although the mother reported potential intensive parent-child communication during the cartoon time, in the parent-recorded videos of watching cartoons, no parent-child interaction appeared. This could be due to the limited recording time. But when discussing the language use during the activity of watching videos, considering the mother's narration and the translanguaging feature of Wangwang's bilingual language use, oral Chinese was agreed to be added in this activity.

Besides, another change in Wangwang's video-watching activity is that he stopped using *YouTube Kids* and started using *BBC iPlayer* by the time of the second and third interviews. The reason behind this was tightly related to parental mediation. As his mother mentioned in the first interview, she used some restrictive PM strategies (Zaman et al., 2016) to monitor Wangwang's video-viewing activity while letting him choose videos he wanted to watch within a selected scope. For example, she set rules for the length and frequency of watching videos, and said, *"我会一直监管他的这个播*

放列表 [I would always supervise his playlist]。"

And she always filtered the proper contents for Wangwang. As she said in the third interview, *"我一直在关注，他在看的就是我一直要的，教育类，音乐类，然后故事情节类的，然后没有暴力 [I' have been keeping a close eye (on it), what he is watching is what I want (him to watch): educational, music-related, and story-based contents, and no violence]。(Quote 4.6.26)"*

Besides, the mother adjusted Wangwang's use of video apps according to some criteria she set by the time of the second interview. Comparing *YouTube Kids* and *Netflix*, the mother believed that *YouTube Kids* was not helpful in helping Wangwang develop logical and complete expressions, and the contents in *YouTube Kids* were hard to monitor. As the mother explained in the second interview,

> *"我发现 YouTube 它推送的有问题 [I find that the YouTube recommendations are problematic]。它推送的内容有一部分是游戏类的 [Some of the contents it recommended are game-related]。孩子整个那个状态就很痴迷，就是一天不看游戏就不行了，必须要看游戏 [(My) child becomes completely obsessed, feeling that he cannot go through a day without watching games; he must watch game (videos)]。(Quote 4.6.27)"*

In the above narration, the mother worried that Wangwang had potential problems of being addictive to watch game videos on *YouTube Kids*. However, she found it tricky to monitor Wangwang's video contents when using this *YouTube* app, as the automatic recommendations based on the app algorithm could present some game contents that she thought were inappropriate for Wangwang to watch. Compared to *YouTube*, the mother believed the contents on *Netflix* and *BBC iPlayer* were more authorised and educational. For example, some cartoon videos on *YouTube* were uploaded by random users and lack consistency, but the same cartoons were in complete episodes on *Netflix* and *BBC iPlayer*. As she explained in the second interview,

> *"像 Netflix 呢，它是有官方认证的，而且它每一个都是有完整的一集 [For Netflix, it (cartoons) has official certification, and every (video) is a complete episode]。比如说拿 'Paw Patrol' 为例，YouTube 它只是剪一个一小片段组合起来 [Taking 'Paw Patrol' as an example, on YouTube, they just combine small clips together (in a video)]。逻辑上啊还有事情发展上，没有完整性 [Logically and in terms of story development, it lacks completeness]。…不连贯了之后 Wangwang 说话就是颠三倒四的 [As (the videos) are incoherent, Wangwang talks in a chaotic or disorderly manner (after watching these videos)]。(Quote 4.6.28)"*

The incoherent video contents negatively influenced Wangwang's expression; his mother spotted this problem, and she adjusted it and let Wangwang use more official and complete video resources on *Netflix* and *BBC iPlayer*. As she further explained in the second interview, *"我买了两个 accounts，BBC iPlayer 和 Netflix 我都买了 [I bought two accounts, both for BBC iPlayer and Netflix.]。然后 BBC 的那个 'Numberblocks'，非常好，有很多的知识性的 [Then, the 'Numberblocks' on BBC, is excellent and very*

informative]。(Quote 4.6.29)"

In some heritage families, parents' perspectives and behaviours play a crucial role in shaping their children's digital literacy practices (Little, 2019). Similarly to his screen-viewing activity, Wangwang's other touchscreen activities were carefully selected and monitored by his mother. His mother would adjust Wangwang's touchscreen apps and activities not only according to her observation of potential harms but also according to his changing educational needs.

For example, by the time of the second interview, the mother believed that these educational apps mentioned in the first mediagram did not suit Wangwang's further learning needs, so she deleted those apps except *Todo Maths*. And to meet Wangwang's new learning needs in music class, she downloaded a new app called *My baby Piano*. As the following conversation in the second interview showed:

> *M：上音乐课的时候他们会学到这个，音名 [During (Wangwang's) music class, they will learn this, the musical note names]。老师让我们记下来，我觉得很难 [The teacher asks us to memorize them, and I find it difficult]。…我们就用那个 app 来学习音乐知识 [We use that app to learn music knowledge]。现在还是蛮有用的 [It is quite useful for now]。我们就每周会抽出两天的时间来用那个来学 [We choose two days a week to learn (musical note names) with it (i.e., My baby Piano)]。*
>
> *R (researcher)：明白，也是您陪着他用这个来学 [I see, do you accompany him in using it to learn (musical note names)] ?*
>
> *M：对 [Yes]。*
>
> *(Quote 4.6.30)*

The co-use and active PM strategy of "participatory learning" (Zaman et al., 2016, p. 12) in touchscreen activity fostered parent-child interactions. Like playing *Todo Maths* and other touchscreen apps, while playing *My Baby Piano*, English was still the main language used in this activity, but the mother would use oral Chinese to help Wangwang play with it. The following example in the second set of parent-recorded videos demonstrated their language choices.

> *(Wangwang is playing My Baby Piano app. The sound effect of each virtual key will come out accordingly when he presses each key on the screen.)*
>
> *M：'do'的音阶名是什么呀 [What is the note name for 'do'] ?给妈妈按出来 [Press it for mom]。*
>
> *W (Wangwang speaks while he presses the left virtual piano key C): C!*
>
> *……*
>
> *M：这是 'ti-ti' 音，按两下 [This is the 'ti-ti sound', press twice]。*
>
> *W (Wangwang presses the virtual piano key B twice):要按 **DI** (二, pronounced as /èr/ in Mandarin)次 [Need to press (it) twice]！*
>
> *……*
>
> *M：好，那么给妈妈按一个'mi'，'mi'是什么音阶名 [Okay, then press 'mi' for mommy. What is the note name for 'mi'] ?*
>
> *W (Wangwang speaks while he presses the virtual piano key E): 这个 [This one]。*

(Quote 4.6.31)

Image 41 Wangwang playing with My Baby Piano

Researchers believe that with well-designed apps, parent-child interactions can facilitate the achievement of specific educational goals (Sheehan et al., 2019). In this example, the mother spoke Chinese to help Wangwang practise the musical note names and corresponding solfège. Oral Chinese was used as the main language for the mother to give instructions. Similarly, Wangwang used complete Chinese to respond to his mother's instructions (as the underlines show), and he pronounced the note names in English while pressing the corresponding virtual piano key on the screen.

4.6.3.3 Wangwang's third mediagram

Compared to the second mediagram, while the four activities were maintained, three new touchscreen activities were added in the third mediagram. Similarly, as in the first and second mediagrams, almost all apps were downloaded in the English version except *TikTok*. *TikTok* was an app in Chinese that Wangwang and his grandmother played together on his grandmother's phone. As his mother said in the third interview, *"用抖音看那个舞蹈类的，然后有的时候也会用抖音去搜一些诗词 [(Wangwang) uses TikTok to watch some dancing videos and sometimes also uses TikTok to search for some Chinese poems]。我叫我妈去搜一些诗词然后教给他 [I ask my mother to search for some Chinese poems and then teach him]。" (Quote 4.6.32)*

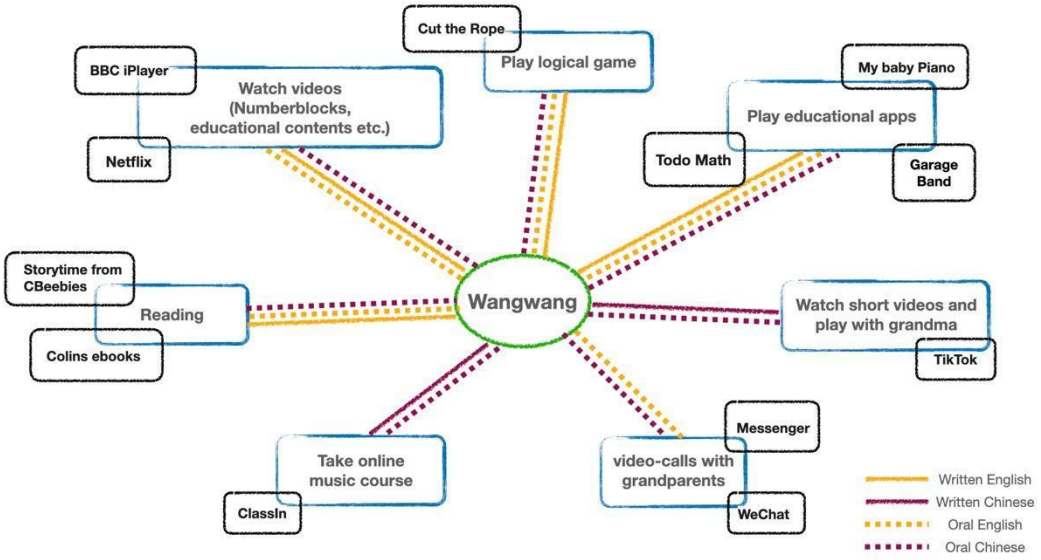

Image 42 Wangwang's third mediagram

As an app that mainly contained short videos, the use of *TikTok* in Wangwang's case was different from his previous use of *YouTube*, which was also for watching video clips. While Wangwang could choose and watch videos on *YouTube* independently from time to time, the use of *TikTok* was always with his grandmother's accompaniment and the contents were filtered and selected by his mother and grandmother. Therefore, the use of *TikTok* also demonstrated a level of parental and adult mediation. Moreover, as his grandmother only spoke Chinese, Wangwang used this app to learn some Chinese poems and watch some entertaining short videos in Chinese context with his grandmother; only oral and written Chinese was used during this activity.

Another big change in Wangwang's touchscreen activities was to use some e-book apps to develop his English reading and comprehension. By the third interview, the mother added the use of these English reading apps into Wangwang's daily routines. As the mother explained about Wangwang's daily touchscreen use in the third interview,

> *"那个 BBC Story 一星期应该用也两次，不会太久，因为他太多东西要做了 [We use BBC Story (i.e., the app is called Storytime from CBeebies) probably twice a week, not for too long, because he has so many things to do]。然后他 To Do Math 随意，然后 Collins 呢是每天五分钟到十分钟 [Then he uses To Do Math as he likes. And for (the use of) Collins (i.e., Collins e-books), it is about five to ten minutes daily] 。因为我们每天会有半小时的学习时间，二十分钟的读书时间 [This is because we have a half-hour study session every day and twenty minutes of reading time]。"(Quote 4.6.33)*

From this narration, we can see that Wangwang's touchscreen use was still highly mediated and structured by his mother; most of the apps that Wangwang used were educational by the time of the third interview.

As for the use of reading apps, the app called *Collins e-books* was downloaded based on Wangwang's school recommendation, and *Storytime from CBeebies* was

downloaded by searching in the app store by the mother. Both apps were designed in English, and the mother believed, *"我觉得 apps 对孩子学习有好处 [I think apps have several benefits for children's learning]。(Quote 4.6.34)"*

For example, the apps could facilitate Wangwang's English accents. As she mentioned in the third interview,

> *"第一个，英文它能够读的更加清楚，没有口音 [First, the English pronunciation (in apps) is clearer and without an accent]。第二个的话呢，它的资源比较丰富 [Second, they offer abundant resources]。…我觉得超级有用，比我自己读好多了 [I find them very useful, much better than me reading (to Wangwang) on my own]。"(Quote 4.6.35)*

Some scholars believe that some well-designed e-books on touchscreens can facilitate children's literacy development, particularly during the co-use activities between parents and children (Mifsud et al., 2021). Rowe and Miller (2016) found that e-books on touchscreens enabled children to interactively practise words and images during storytelling activities. Meanwhile, the mother also mentioned that these English reading apps were used with her assistance and in two oral languages. She further explained how to use these apps in the third interview:

> *"其实就是英文的读一遍，然后翻译成中文的 [Actually, it is mainly about reading once in English, and then translating it into Chinese]。这样就是英文的问一遍，他听不懂我再用中文去说 [So, (he listens) to English first; if he does not understand, I will repeat it in Chinese]。然后他回答我英文的或者中文的，我再帮他去翻译一下 [Then he responds to me in either English or Chinese, and I will help him translate into the other language]。所以说一旦用这个 apps 就是两种语言去用 [So, when we use these apps, we use both languages]。"(Quote 4.6.36)*

Therefore, during their co-use of reading apps, Wangwang learnt to read and understand the written English contexts in these apps and practised both oral Chinese and English as his mother communicated in both languages with him. The mother's language use matched the finding in Harrison and McTavish's (2018) study with Chinese (Cantonese)-English bilingual girls. Like the FLP in other touchscreen activities and family communication mentioned previously, translation between the two languages was also common in this activity. This kind of translation between languages is a way of code-switching practised by the mother (Song, 2016). The family members and the child used the two languages flexibly, which played a vital role in enriching the children's linguistic skills in both English and Chinese (Song, 2016). In Wangwang's case, her mother's translation helped him develop both oral Chinese and English in the activity and facilitated his English story reading and comprehension.

Besides all the apps with educational features, the only game that the mother believed to be entertaining was one game called *Cut the Rope*. The family sometimes played this app together. Although she thought this was an entertaining app, she still mentioned the potential educational purpose of using this app in the third interview, *"锻炼他的逻辑能力 [(It can) practise his logical skills]。(Quote 4.6.37)"* Similar to the other activities, Wangwang's parents spoke mainly oral Chinese, while Wangwang spoke both Chinese and English when using this app.

When looking into Wangwang's touchscreen use in general, he developed both languages throughout his engagement with different apps. First, as most of the apps he used were downloaded in the English version, his English digital literacy (Kumpulainen & Gillen, 2019) was facilitated. For example, the use of *Collins e-books* provided accurate English pronunciations, which the parents lacked. Wangwang engaged with this app to practise his English listening and speaking skills and developed his English reading ability. Similarly, Wangwang developed his maths skills while developing his digital literacy of English by using the app *Todo Maths* in English. As for the development of Chinese, although some traditional non-digital ways, such as going to a weekend Chinese class, were applied, Wangwang also had opportunities to practise his Chinese language and literacy skills during some touchscreen activities. For the activities of taking an online music class and playing *TikTok* with his grandmother, he practised his Chinese in a monolingual language environment. For example, Wangwang learnt Chinese songs and read Chinese lyrics online with his Chinese monolingual teacher. And he learnt some Chinese poems from his grandmother who could only speak Chinese.

4.6.4 Summary

As a four-year-old boy, Wangwang spoke both Chinese and English in his daily family life. While his parents mostly spoke to him in Chinese, they occasionally switched to English, preparing him for school and social scenarios. The mother believed that Wangwang spent a long time communicating with his father, and he imitated his father's oral expressions and therefore had some accents when speaking. However, throughout the data collection and the examples mentioned above, Wangwang's oral expressions were not necessarily related to the pronunciations of these dialects. His accents in both Mandarin Chinese and English were more likely related to children's accents at a developmental stage instead of influenced by his complicated language exposures. This feature of his language use sometimes affected his clarity in both languages. Looking into Wangwang's FLP, the parents also paid attention to Wangwang's difficulties and problems in developing both languages and applied certain language management strategies to help him improve both languages, especially his bilingual oral skills. For example, the mother always corrected Wangwang's wrong pronunciations in Chinese, and she would translate between Chinese and English to let Wangwang know vocabulary or expressions in both languages.

In terms of the language used during Wangwang's touchscreen activities, English was the dominant language for the apps he used, and he spoke more complete English while using certain apps in the English setting. Using educational apps in the English version also helped Wangwang develop other knowledge, such as maths. As for the development of Chinese, oral Chinese was still the main language that the mother used to communicate with Wangwang during his touchscreen time. Several examples illustrated that Wangwang would speak complete Chinese sentences during his touchscreen use as well, and sometimes translanguaging (Song, 2016) took place while he spoke. During his touchscreen time, Wangwang sometimes engaged in complete Chinese environments and developed his Chinese literacy. For the non-digital ways, apart from the daily family communication and translation/code-switching, more traditional ways of developing Chinese were used in Wangwang's case, such as reading textbooks and finishing the homework of the weekend Chinese class.

Another feature of Wangwang's use of touchscreens was that these activities and contents were largely influenced by parental attitudes and parental mediations. The mother monitored Wangwang's touchscreen use actively; no gaming apps or

inappropriate contents were allowed. These activities and use of apps changed from time to time and were adjusted and tested by the mother, mainly for achieving better educational goals. Therefore, the iPad functioned mainly as a tool to study and meet educational purposes rather than for entertainment. Co-use activities between Wangwang and his mother were common in most of Wangwang's touchscreen activities; his mother would accompany his touchscreen use frequently and translate between Chinese and English continuously.

Chapter 5 Cross-Case Analysis

From the above individual analysis of each case, every family had specific family touchscreen adoption patterns, diverse family language policies, and multilingual literacy practices. In this chapter, the common features and individual differences of these families' touchscreen adoptions and language choices will be compared and discussed, with a focus on parents' roles.

5.1 Children's Language choices

All six children demonstrated their special understandings of languages that they were exposed to in their daily family life and touchscreen activities. According to Bronfenbrenner's bioecological model, the characteristics of the developing person (force, resources, and demand characteristics) can significantly shape their proximal processes and developmental outcomes (Bronfenbrenner & Morris, 2006). In my study, different characteristics of the developing children influenced their language choices during interpersonal interactions and their engagements with touchscreens. These characteristics related to the defining property Person in Bronfenbrenner's bioecological model will be discussed in the following sections.

5.1.1 Children's perceptions of languages

First, these children demonstrated different understandings and knowledge about their heritage languages (HLs) and English. Some children showed clear knowledge about their bilingual/multilingual languages, while others were less familiar with the terms or concepts of languages. Children's knowledge of languages is one type of resource characteristic of the developing person; it varies and significantly influences how proximal processes (i.e., interactions with people and objects) take place (Bronfenbrenner & Morris, 2006).

For instance, Feifei, as a trilingual girl, could distinguish and switch languages when speaking to different people in varied scenarios; she also knew the terms for all the three languages she spoke during the LP activity at the beginning of the first interview (see *Quote 4.1.13*). Similarly, Mango talked about the three languages that he could speak with correct terms and the different scenarios when he used these languages. For example, Mango mentioned that he mainly spoke Chinese and English at home, and he sometimes spoke French with teachers in school (see *Quote 4.2.4*). As for Vicky and Wangwang, when doing the LP activities and talking about the languages they could speak, they could distinguish Chinese and English as two languages, although they did not know the terms of the languages at the beginning. Instead of recognising these two languages as Chinese and English, with the hints given by their mothers, they could distinguish the two languages based on how they communicated with different people in different scenarios. For example, they both identified English as a language they spoke at school, while Chinese was a language they spoke at home or with family members (see *Quotes 4.5.1* and *4.6.1*). As for Tutu, although she did not show clear understandings to distinguish the two languages, she could tell the differences of the same word in both English and Chinese in the LP activity (see *Quote 4.4.1*). Similarly, Moe could not distinguish the two languages that she was exposed to in the LP activity (see *Quote 4.3.1*), and she mainly spoke complete English with her parents, unless when singing some Chinese songs with her mother (see *Quote 4.3.3, Quote 4.3.7*).

Second, the emotional preferences about languages could also influence the children's language choices. The emotional preferences of children on languages belong to the category of force characteristics of a person (Bronfenbrenner & Morris, 2006), in which the dispositions (e.g., motivations and persistence) of a child can influence how they

engage with languages in everyday activities. Five of the children expressed their interest in maintaining and developing their bilingualism/multilingualism positively. Some children expressed their special preferences for speaking their HLs. For example, Mango said that he loved to speak Chinese, and he sometimes would ask his parents to only speak Chinese and no other languages with him, because he felt it was cool and liked the idea that other people did not know that he was talking about when he spoke Chinese (see *Quote 4.2.9*). In a study involving multilingual children in Belgium (Dekeyser & Agirdag, 2021), it was found that these children tend to have emotional ties to a language based on how well they spoke their HL, what languages their family spoke at home, and how important they think their HL and the language they used in schools were. In my study, children's attitudes and language practices towards HL were also influenced by their family members' language attitudes and language use.

However, different from the findings from Dekeyser and Agirdag's (2021) study, instead of forming positive emotions about their HLs based on their language proficiency, some children in my study also showed their emotional preferences for their HLs without being fluent or skilled HL speakers. For example, in Vicky's case, she expressed her love of speaking both languages and preferred the language that she spoke with her mother (i.e., Chinese). She even asked to attend a weekend Chinese class herself and developed not only her oral skills but also her Chinese reading skills in the class (see *Quotes 4.5.11* and *4.5.35*). Similarly, for Feifei, she grew her passion to learn and speak Bahasa Indonesia with her mother after visiting her Indonesian grandmother. She felt proud and happy if she could speak correct Bahasa Indonesia, as her grandmother encouraged her to do so (see *Quote 4.1.3*). HL helps strengthen family relationships and allows a child to recognise their language and cultural identity (Little, 2019; Little, 2023). Although Bahasa Indonesia was the less capable language of Feifei compared to her Chinese and English, she loved to learn and practise this HL driven by emotional preferences and deeper HL identity.

5.1.2 Translanguaging and code-switching

In my case studies, translanguaging (García & Otheguy, 2020; Wei, 2018) took place during many family language practices. In my study, the proportion of translanguaging practice in each child was not the same. For example, for Tutu and Vicky, translanguaging was a significant feature of their language use, as they often mix Chinese and English into one long sentence during communication instead of speaking long sentences in complete Chinese or English (see *Quotes 4.4.23, and 4.5.25*). This was not only in the cases of Vicky and Tutu; translanguaging happened in Mango and Wangwang's language use from time to time (see *Quote 4.2.3, 4.6.13, 4.6.14, and 4.6.23*). Translanguaging was not clearly found in Feifei and Moe's cases.

This kind of language mixing during verbal communications in the four cases of my study was commonly found in other family translanguaging studies as well (Jung, 2022; Karpava et al., 2021; Song, 2016). It is argued that translanguaging practices are beneficial to facilitate family daily communication in an effective way (Karpava et al., 2021). In my study, the children's translanguaging practices often took place during their interactions with family members or me (as a member of the family interviews) if they wanted to explain their ideas clearly and form intensive communication. Looking through the lens of Bronfenbrenner's bioecological model, the different translanguaging practices in each case can be viewed as one type of the proximal processes involving interpersonal interactions to facilitate a child's bilingual development. Applying the PPCT model, while the Time (i.e., translanguaging practices in children's everyday lives) and Context (within the home environment) remained stable, the characteristics of the developing person and the other people

involved during the interpersonal interactions together influence the translanguaging practices in each family. On the one hand, the translanguaging practices of the children form effective communications and demonstrate their creative way and motivations (forces) of fully engaging with their unique linguistic repertoire (resources) for meaning-making and interaction purposes (Wei, 2018). On the other hand, for the parents who are actively involved in the proximal processes of translanguaging interactions, there were differences in how the parents engaged with translanguaging practices themselves when communicating with children. Specific findings related to the influence of parents on translanguaging practices are discussed below.

Similar to Jung's (2022) study, no explicit FLP was implemented in Tutu's family, and the translanguaging practice took place naturally in Tutu's family life. The parents mentioned they used the two languages casually; sometimes they would also mix the two languages into one sentence to meet better communication needs when talking to Tutu (see *Quotes 4.4.3* and *4.4.4*).

However, the FLPs and parental language use were different in the family communication of Mango, Vicky, and Wangwang. In Mango's family, the parents used to mix the two languages when talking to Mango when practising their former language management strategies, like in Tutu's case. Then the parents altered their FLP to meet Mango's educational needs, and they set rules to communicate with Mango in either complete English or Chinese, instead of practising translanguaging themselves. Similarly, in Vicky's case, the parents reflected on their own language habits, and they did not mix languages during family commutations. But Vicky's parents did not require Vicky and her brother to communicate in complete Chinese or English, and translanguaging practices took place naturally between Vicky and her brother. As for Wangwang's family, the mother did not practise translanguaging, mixing the two languages as Wangwang did. Instead, when communicating with Wangwang, she preferred to speak in complete Chinese, and she would translate English into Chinese when Wangwang said something in English to her. For the parents of Mango, Vicky, and Wangwang, they set specific FLPs towards their own language use during communication with their child.

This finding in my study was different from other translanguaging studies with multilingual families, when the parents showed positive attitudes and practised translanguaging at home to form better communication themselves (Jung, 2022; Karpava et al., 2021; Song, 2016). In addition, applying translanguaging practices at home is not only beneficial for family communication; the bilingual child's cultural and language identity can also be forged and enhanced during this language choice (Choi, 2024; Jung, 2022; Karpava et al., 2021). For the parents who did not want to maintain the habits of translanguaging in my study, it was worth considering if limited translanguaging communication had potential harms to their children's engagement of their full linguistic repertoire and develop their bilingual identity afterwards.

5.2 Family language policy (FLP) and language choices

As mentioned above, there were different FLPs that influenced parents' actual language management and practices at home. The details of the FLPs in each family and their language choices will be discussed below.

5.2.1 Family language policies (FLPs)

When studying bilingual children's home language practices, it can be vital to look through the lens of family language policy (FLP) (Curdt-Christiansen, 2009). FLP refers to the overt and subtle strategies regarding the specific use of language and literacy

activities within the household and among family members (Curdt-Christiansen, 2016; Wilson, 2020). Like Wilson's (2020) study on FLP of five French-English families in the UK, my study also involved children, to make sure that their voices towards FLP were heard, as well as other adult family members' opinions.

The main features of each family's FLP and each participating child's oral language choices are summarised in the following *Table 2* accordingly.

Children	FLPs	Language choices
Feifei	Altered one part after visiting Indonesia; more Bahasa was added during Feifei and the mother's communication. The mother sometimes translated English into Bahasa for Feifei. Before this, only English was used during their communication. The rest of FLP remained stable and clear. Her father spoke with Feifei in Chinese and helped her to develop written Chinese skills. Based on the actual communication needs, but strictly varied when communicating with different family members; Positively maintained and practised the HLs. Developed mainly oral skills in all languages and some written Chinese.	Feifei spoke: Chinese with her father and family members in China; English and Bahasa with her mother and family members in Indonesia; English in nursery. Feifei preferred to speak more Bahasa with her mother and grandmother rather than English after coming back from Indonesia. No translanguaging took place.
Mango	Altered for the preparation of the 7 plus exam. Before preparing the exam: Based on the actual communication needs, there were no strict rules for using specific languages. Most conversations between family members were in Chinese but they often mixed the use of English and Chinese in one sentence. When preparing the exam: The parents changed to speak with Mango in complete Chinese or English instead of mixing the two languages; They communicated in English	Mango spoke: both Chinese and English with his parents, and sometimes with other family members; English and French at school. Mango still felt proud and was willing to speak his HL Chinese after the change of FLP. Translanguaging took place.

	when discussing exam-related topics and in Chinese for daily routines. They would correct Mango if he spoke in two languages together. Developed mainly oral skills in both languages and written skills in English.	
Moe	Rather stable. Mainly based on the actual communication needs among family members, and English was the dominant language. Developed mainly oral skills in both languages.	Moe spoke: English mainly with both her parents, her little sister, and other family members; a few Chinese words sometimes and sang some Chinese children's songs. No translanguaging took place.
Tutu	Rather stable. Based on the actual communication needs. Most conversations between family members were in Chinese, but they often mixed the use of English and Chinese in one sentence. Developed mainly oral skills in both languages and few Chinese written skills.	Tutu spoke: both Chinese and English with her parents, and sometimes with other family members; maybe English at nursery (not clear). Translanguaging took place.
Vicky	Rather stable. The parents communicate with Vicky mostly in complete Chinese or English. But Vicky and her brother communicated in both Chinese and English at home, based on their communication needs. Vicky went to a weekend Chinese school. Develop both oral and written skills in both languages.	Vicky spoke: both Chinese and English with her parents, her brother and with other family members; English at school; mainly Chinese and a little bit of English with her Chinese teachers. Vicky showed interest and asked to go to the weekend and online Chinese classes herself. Translanguaging took place.
Wangwang	Rather stable, strict, and clear. The parents mostly communicated with Wangwang in Chinese. But	Wangwang spoke: both Chinese and English with his parents and his grandparents in Malaysia;

	Wangwang spoke both English and Chinese at home. The mother always corrected Wangwang's Chinese pronunciations and sometimes translated English into Chinese during communication when Wangwang spoke English. Wangwang's parents taught him school-related topics in English, for example, maths. Wangwang went to weekend Chinese school. Developed both oral and written skills in both languages.	English at school; Chinese with his Chinese music teacher and his Chinese grandmother. Translanguaging took place.

Table 2 FLPs and language choices

As we can see from *Table 2,* the FLP of each family was different and unique. As Roberts (2023) pointed out, some previous FLP research only described a FLP at a specific moment instead of a period. However, FLP should be viewed as a continuously changing system that is closely linked to the understanding of space and time (Roberts, 2023). In my study, the constant changing nature of FLPs in the six families is valued, and the alteration of the FLPs mentioned during the period of data collection are also studied.

For Moe, Tutu, Vicky, and Wangwang, their FLPs remained rather stable throughout the data collection, while Feifei and Mango's FLPs had been adjusted to meet new sociocultural needs, such as communicating with monolingual family members and pursuing better academic performance. For Feifei, as she showed great interest in developing her HL Bahasa Indonesia, her mother altered the original FLP between Feifei and her to meet Feifei's language preference (see *Quote 4.1.2*). For Mango, the reason for altering FLP could be more external, as the parents found that their old FLP and the previous way of Mango's language use could limit his school performance in English, because he could not understand his school contents in only one language to some extent (see *Quote 4.2.6*).

Moreover, the FLPs in these families also reflect different parental language management styles (Wilson, 2020). One main aspect of FLP research is the connection between the strategies parents use to influence language practice at home and how well children can speak their HL (Wilson, 2020; Curdt-Christiansen, 2009). Looking into the parental views on HL maintenance and FLP of each individual case study analysis, all the parents demonstrated positive attitudes and beliefs to help their children maintain and develop their family HLs. All the Chinese-heritage parents made efforts to create Chinese-speaking environments at home at different levels, and some of them used other strategies to facilitate the child's HL development as well as the English learning. However, the degree of parental mediations on their children's daily HL practices are not the same. For Tutu and Moe, their FLPs had few restrictions and were mostly for meeting daily communication needs without paying attention to developing specific language skills in one or more languages. Their parental mediations on both the parents' and the child's language use were flexible and casual. Therefore, when looking into their language choices in daily life, Tutu spoke both

Chinese and English with people almost all the time. For Moe, she barely spoke Chinese and was used to communicating through English. None of them could clearly distinguish the two languages.

As for Feifei, Vicky, Wangwang, and Mango, the parents were more aware of their ways of communicating with the children, considering the specific languages that they used. For example, for Vicky and Mango, their parents mentioned that they deliberately communicate with the children in one complete language instead of letting translanguaging happen unconsciously when they spoke. Both Vicky and Mango could distinguish the languages to some extent. Despite managing their own language use, the parents did not strictly manage the language use of Vicky and Mango. Translanguaging was also common in the two children's utterances. Differently, for Feifei and Wangwang, the parents were more aware of applying clearer and stricter FLP. Specific parental strategies, such as translation and correction of pronunciations, appeared in their FLPs to support their HL development. For example, Wangwang's mother would correct his Chinese pronunciation during conversation, and she would translate English into Chinese when Wangwang spoke with her in English. Similarly, Feifei's father would also ask Feifei to only communicate with him in Chinese, and Feifei's mother would translate between English and Bahasa to help Feifei develop new Bahasa expressions.

Studies pointed out that parents' agency and language beliefs can significantly influence the formation of FLP and HL maintenance and development (Shen & Jiang, 2023; Curdt-Christiansen, 2009). Therefore, as seen from the above analysis of the varied parental mediations and FLPs in my study, for the families with clearer FLP strategies and language goals, their parents often applied stricter language management and mediation strategies on their own and their children's specific language uses. For the parents who focused more on meeting daily communication needs instead of the use of specific languages, more casual and less specific language mediation strategies were found. From the perspective of the bioecological model, the important role of parents in mediating their FLP is one example to demonstrate how other people involved in the proximal processes significantly influence the proximal processes of a developing person (Bronfenbrenner & Morris, 2006). Based on my findings, parents' language attitudes (forces) and specific FLP strategies (resources) can greatly influence parent-child interactions and how children practise languages within family contexts (proximal processes).

5.2.2 Children's agency and the development of bilingualism

As discussed in 5.1, children's language choices can be influenced by multiple factors. Their understanding of languages can be mainly fostered through the daily communications within the family environment (Shen & Jiang, 2023). Apart from parental values and strategies, children's agency and their perspectives on the FLP should also be valued when exploring their language choices (Shen & Jiang, 2023; Wilson, 2020). When parents start the process of creating and forming FLPs, the children also engage with the FLPs with their own perceptions and creations (Shen & Jiang, 2023).

It is argued that children and parents may hold different opinions about their (Wilson, 2020), and both of their perceptions should be investigated (Shen & Jiang, 2023). For example, in Wilson's (2020) study, a child reported that she felt frustrated when she tried to communicate with her parents in HL French, because the parents focused too much on correcting her grammar instead of focusing on the communication. Similarly, in Wangwang's case, his mother always corrected him during communication. Instead of expressing his emotions directly, Wangwang sometimes refused to repeat the

Chinese words that his mother said and insisted on expressing the words in English (see *Quote 4.6.11*). However, this example did not mean that Wangwang was negative about his HL development; in other examples and the interviews, he remained positive and spoke Chinese voluntarily from time to time.

In addition, for most of the cases (though not clear in Moe's case), the children expressed their positive attitudes and practised Chinese frequently and voluntarily. For example, as seen from *Table 2* and previous analysis, although Vicky had limited time practising Chinese at home after starting school life, she asked to go to a weekend Chinese class herself to learn more Chinese. Similarly, for Mango, he would set rules of only speaking Chinese with his parents even after entering junior school because he loved this language. These were examples of children's agency in facilitating and adjusting their FLPs.

Like the characteristics of the developing child discussed in section 5.1.1, children also play an active role in organising and practising their FLPs, while their parents play a crucial role in creating and mediating their FLPs. As the examples in the above two paragraphs indicate, children's attitudes and motivations towards languages (forces), their behaviours and actions on using languages during parent-child interactions (resources and demands), influence these proximal processes and how their parents react to their language choices (Bronfenbrenner & Morris, 2006).

5.2.3 The beginning of school/nursery

According to the PPCT model, as the four defining properties work in a synergistic way (Navarro et al., 2022), the change of contexts and time can lead the proximal processes in another direction (Bronfenbrenner & Morris, 2006). Considering Time from three levels, the beginning of school/nursery is a big life event that makes consistent and long-term change in a child's everyday life and their development (Bronfenbrenner, 1994; Guo & Lee, 2023). For all the children in my study except Moe, they all went to mainstream schools or nurseries, where English was the only language used. The change of Context from the home environment to the school environment can influence several proximal processes and the bilingual development of these children as well. Similar to Mango's case, parents in other studies also choose to decrease the time their child engages with HL to improve their performance in the dominant language used in school (Tang & Zheng, 2023; Curdt-Christiansen & Morgia, 2018), even though being exposed to the HL can inspire the child to become multilingual speakers and shape their language identity (Little, 2019). Parents of Tutu and Wangwang noticed the change in their children's language use after they went to school/nursery for a while. The children spoke more English words or sentences at home compared to before starting school/nursery.

One thing worth mentioning is that the decrease in HL time may not be voluntary. For example, as Vicky's mother said that Vicky only had limited time to practise Chinese at home when she spent 6 to 8 hours at school where only English was spoken. In most cases in my study, the parental and children's attitudes towards HL maintenance did not change much before and after going to school/nursery, and the decreased amount of HL exposure after going to school/nursery did not show a necessarily negative influence on the children's HL development. For instance, Feifei's parents did not show concerns about Feifei's English capacity or school performance when she entered nursery, and they continued practising their FLP, which focused more on developing both HLs at home. Similarly, in Tutu's case, both her Chinese and English kept developing during the period of data collection after she went to nursery. Tutu's grandmother would tell her bedtime stories in Chinese after school, and the mother observed Tutu's language growth in both languages. Even for Mango, despite the

altered FLP on the parents' oral language use, Mango's parents did not suppress Mango's Chinese utterances and downloaded a Chinese app for him based on his language interests.

From the discussion about the FLPs in different families, their FLPs are influenced by several factors, such as parental language mediations (Shen & Jiang, 2023), the child's active role (Wilson, 2020), and societal factors (educational needs and communicational needs) (Roberts, 2023). For some families in my study, they altered their previous FLPs to meet new needs, so the FLP in each family should be viewed as unique and fluid through different time and spaces (Roberts, 2023).

5.3 Home touchscreen adoptions and language choices

Among all the cases in my study, touchscreen devices, mostly the parents' mobile phones and iPads, were available and accessible in their daily family life. After discussing the general pattern of these young bilingual/multilingual children's home language choices, their language exposures and practices during the home touchscreen activities will be compared and analysed below.

5.3.1 The patterns of touchscreen adoption

The patterns of the touchscreen adoption of these children are listed in *Table 3*.

Children	**Frequently used apps**	**Usual touchscreen activities**	**Parental mediation (PM) strategies**	**Language exposures**
Feifei	*Baby Math Training*, *Code Karts*, *Wukong Maths* (added by the third interview), YouTube, *Wukong Literacy*, Camera, and Photos	Played educational games; Watched cartoons (the first two interviews), changed to watch more introductory videos (by the third interview); Learnt Chinese; Took picture and checked photos/videos for storytelling	Filtered and downloaded age-appropriate apps for Feifei (restrictive); Monitored the contents of apps and videos (restrictive); Always accompanied Feifei's touchscreen use (active and co-use). Purchased apps for her (active).	Oral English Oral Chinese Oral Bahasa Indonesia Written Chinese Written English
Mango	Spotify, *Time Tables Rock Stars*, YouTube, Among Us, *iHuman Chinese*	Watched videos; Studied maths; Listened to music and story; Learnt Chinese characters	Filtered and downloaded proper apps for Mango (restrictive); Monitored the	Oral English Oral Chinese Written English Written Chinese

	(added by the third interview)		contents of apps and videos (restrictive); Set rules on time and apps limits (restrictive); Let Mango play apps alone with in-app timer settings and stay nearby (restrictive and distant). Negotiated with Mango and purchased an app for him (active).	
Moe	YouTube to YouTube Kids, Peppa Pig: Polly Parrot, Toddler Puzzles Game for kids: doddle games, Drawing for kids, *LEGO DUPLO WORLD*, *Dr. Panda Restaurant*, *Sago Mini World: Kids Games* (added by the third interview)	Played educational games; Played colouring games; Played jigsaw games; Watched cartoons and videos	Let Moe download and delete apps as she wanted (active); Let Moe play apps alone and sometimes supervised (distant); Accompanied Moe when she asked them to (co-use and active). Purchased apps for her (active).	Oral English Oral Chinese Written English Written Chinese (in only one app)
Tutu	Baby Panda World-Babybus, Paw Patrol Rescue World, GarageBand	Played games; Drew things with app screen	Gave Tutu a personal iPad and set child's accounts for her (restrictive and distant), then let her use touchscreen freely (active); Set time limits (restrictive); Let Tutu play apps alone and supervise sometimes (distant); Accompanied	Oral English Oral Chinese Written English

			Tutu when she asked (co-use and active).	
Vicky	*YouTube Kids, IXL Learning,* Siri, Simply Piano (added by the third interview)	Spoke to Siri, Learnt maths and English Watched cartoons and videos; Practised piano with app screen	Filtered and downloaded proper apps for Vicky (restrictive); Set in-app time limits (restrictive and distant); Let Vicky play touchscreen with her older brother (co-use and active).	Oral English Oral Chinese Written English Written Chinese (in only one app)
Wangwang	*Todo Maths*, YouTube Kids (stopped use after the first interview) *Netflix*, *BBC iPlayer* (added by the second interview), My baby Piano (added by the third interview), ClassIn	Play educational games; Watch cartoons and videos; Take online music course	Filter and download proper apps for Wangwang (restrictive); Set time and content limits (restrictive); Accompanied Wangwang when have time (co-use, active); Let Wangwang watch videos alone and supervise his in-app playlist sometimes (distant). Purchased apps for him (active).	Oral English Oral Chinese Written English Written Chinese

Table 3 Children's touchscreen use patterns

As shown in *Table 3* above, each child has some unique touchscreen activities, as well as some common ones. One popular touchscreen activity among five children was watching videos, such as cartoons and early childhood contents. Tutu did not use a touchscreen to watch videos; she used the computer instead. Similar to Marsh and her colleagues' (2018) study with English-speaking children under five years old in the UK, for this screen-viewing activity in my study, *YouTube* and *YouTube Kids* were frequently used apps in most families. Others also use other similar apps, such as *BBC iPlayer* and *Netflix*. Besides this popular screen-viewing activity, the other touchscreen activities varied among families. With the help of different apps, children could engage in multiple touchscreen activities, such as communicating through video calls and playing games (Rideout & Robb, 2020; Ofcom, 2024).

As seen from Table *3*, I noticed that the families in my study tended to choose apps

whose designs restricted agentic personalisation (Kucirkova, 2019) whether consciously or subconsciously. Many of the frequently used apps in these families are designed for children, including the consideration of automatic personalisation and used algorithms to recommend and adjust contents based on a child's data of using the apps (Kucirkova, 2019). The use of apps with educational features or aimed at achieving educational goals in a special area also seemed to be common in several cases. One exception is Tutu's case; her mother believed that Tutu's touchscreen use was for meeting her own entertaining needs rather than any educational needs (see *Quote 4.4.15*). In contrast, Wangwang's touchscreen use was totally different. As Wangwang's mother believed that Wangwang's use of touchscreens should be mainly for learning and educational purposes, even playing games and watching videos should be viewed as a way of acquiring knowledge in different fields (see *Quote 4.6.19*). More about parents' role in children's touchscreen use and language choices will be discussed in section 5.5.

In addition, for all the apps in *Table 3* that are highlighted in italics, they are all paid apps and not free ones. Research has shown that using free apps could increase the risk for children being exposed to in-app advertisements repetitively compared to paid apps (Chaudron et al., 2019). Parents, as gatekeepers, can provide access to touchscreen devices and apps to their children, by checking and purchasing appropriate apps (Little, 2019). In my study, the parents of Feifei, Mango, Moe, and Wangwang all mentioned their positive opinions of purchasing some apps for their children. Most of them believed that buying these apps for their children was beneficial; they were especially positive about purchasing some apps that were designed to meet certain educational purposes, and they were financially able to do so. For example, Feifei's father said that he would check the app store and purchase apps that he thought could be beneficial for Feifei, and he would use and test these apps himself before letting Feifei use these apps (see *Quote 4.1.20*). Similarly, Mango's mother also said that she believed that buying the Chinese learning app for Mango was a good decision, since he could learn Chinese characters in that app independently and achieve good results without any ad interference (see *Quote 4.2.24*). While some children's apps are carefully designed to be entertaining and educational at the same time, for children, the actual line between the learning and entertaining elements may be blurred while they use the apps (Little, 2020). For example, one of Wangwang's most frequently-used app was *Todo Maths*, the app was designed for early learners to develop basic maths skills. The activities designed in this app were mostly entertaining and with gaming features, which could motivate Wangwang to use this app and practise his maths skills in English (see *Quote 4.6.21*). For Moe, her mother purchased a lot of apps, and she explained that she did not like the app *Talking Tom*, which had many advertisements in it and negatively influenced the playing experience (see *Quote 4.3.26*).

The purchase of apps is a way to facilitate and support their children's touchscreen activities and is one strategy of active mediation (Zaman et al., 2016). As mentioned in *Table 3*, several parental mediation (PM) (Zaman et al., 2016) strategies in each child's home touchscreen use were found. These PM strategies on the children's touchscreen use and their language practices during their touchscreen time will be discussed in detail in 5.5.2.

5.3.2 Multilingual language exposure during home touchscreen use

The children's multilingual language exposures during these home touchscreen activities can also be seen from *Table 3*. When talking about language exposure here, it means the general appearance of the oral and written forms of all the languages in children's touchscreen activities. For all six children, they were exposed to both oral

English and Chinese during their touchscreen time. For Feifei, she was also exposed to Bahasa Indonesia when facetiming her grandmother and playing apps with her mother sometimes. Besides, for the written language exposure, which includes contents like subtitles and hints in games, five of the children were exposed to both written English and Chinese to some extent. One exception was in Tutu's case, where only written English was applied during her touchscreen time since her device and apps were all set in English.

Because the third mediagram represents the finalised touchscreen and language use of each child during data collection. *Table 4* below illustrates different forms of language exposure in each child's touchscreen use using the data of each child's third mediagram as examples.

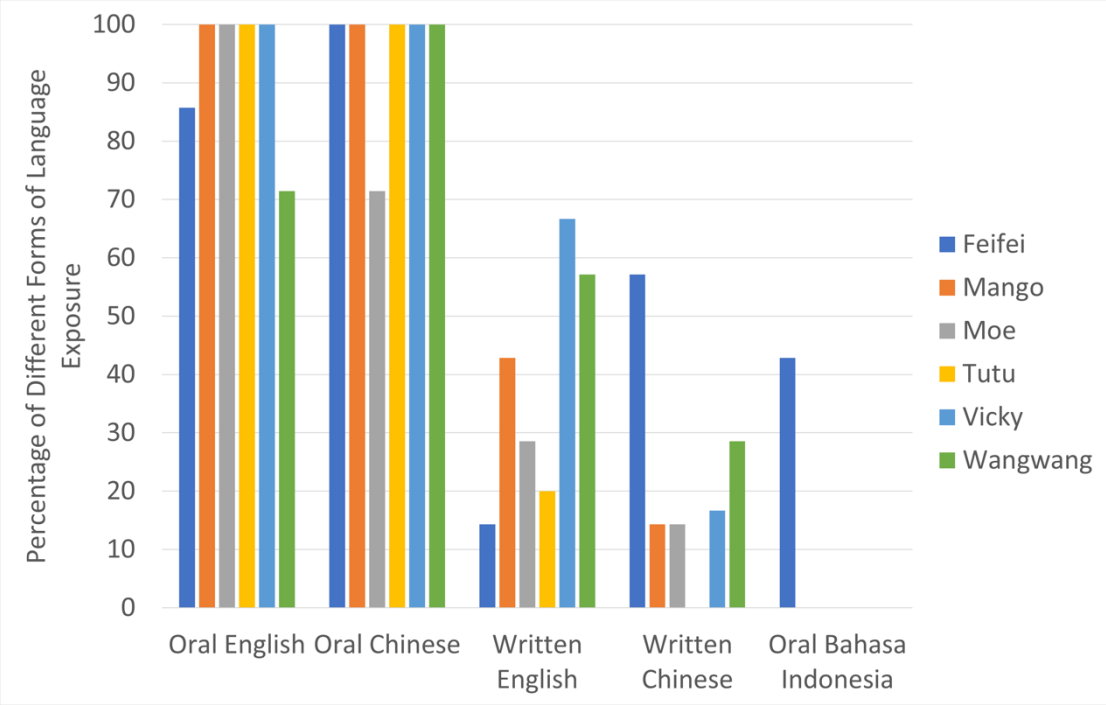

Table 4 Varied language exposures in each child's touchscreen activities

In *Table 4*, each child's touchscreen use is represented by a unique colour, the different forms of language exposures are presented in the axis, and the percentages of each language exposure in each child's touchscreen activities are presented in the y-axis. For all the children, exposures to oral English and oral Chinese were commonly found in most of their touchscreen activities, while exposure to written languages was lower than oral ones in general. Comparing the written English and written Chinese exposures in each individual case, five of them showed more written English exposure than written Chinese. That is to say, written English exposure was found in more touchscreen activities of a child, and written Chinese exposure was found in fewer activities of that child. However, as the data on the adequate frequency of how a child engages with different touchscreen activities was hard to collect or quantify, the *Table 4* above only indicates a general tendency of kinds of language exposures for each child, considering all the touchscreen activities listed in the third mediagrams equally.

There are possible reasons behind the variations in language exposures during a child's multiple touchscreen activities in each case. First, the language settings of touchscreen devices and apps were different among these families. Except for Feifei's family, all the other families reported the difficulty of finding proper apps designed in

their HL, Chinese (see each individual case study analysis). The lack of HL resources is acknowledged as one obstacle that bilingual parents may encounter to support their children's HL maintenance (Huang & Liao, 2024; Liang & Shin, 2021; Park et al., 2012).

However, as discussed in Moe's, Tutu's, and Vicky's case studies, the limited app use in HL could be related to other factors. Sometimes the lack of HL app resources may not be the actual problem of the app designs; some parents may lack awareness of checking the available language options of the apps that their children use or proper technical capacities to switch languages (Little, 2019) in apps or within the touchscreen device settings. For example, in Moe's case, while the mother reported on the limited Chinese resources, one of Moe's favourite apps, *Sago Mini World: Kids Games*, was designed in multiple languages and can be switched to the Chinese version in the app language preference setting within the system settings of the iPad. Also, in Tutu's case, when her mother reported similar concerns, one of Tutu's frequently used apps, *Paw Patrol Rescue World*, was available in 10 languages, including the Chinese version, and the language could be switched within the app. Compared to the multiple parental mediation methods based on the child's touchscreen contents and time limits, some parents in my study lacked the awareness or skills to check the language settings available of their children's touchscreen apps.

Second, children in different families had varied limits and boundaries when accessing touchscreen devices and apps. As shown in *Table 3*, in Tutu, Vicky, and Moe's families, the parents gave the children freedom to download the apps they liked within a limited scope, for example, within a child's account. For Feifei, Vicky, and Wangwang, more restricted PMs were applied; their parents would filter and select apps that they thought were appropriate for the children.

Third, their FLPs and language habits also influenced their touchscreen language exposures and language practices. For example, the oral Chinese and English exposures of Mango, Tutu, and Vicky were all illustrated as 100%, which meant that both oral English and Chinese exposures were found in all their touchscreen activities. The reason behind this could be related to their translanguaging language practices, and this language use influenced their language use during touchscreen as well as in daily communications. More about the digital literacy practices during each child's touchscreen use will be discussed in the following section.

5.4 The children's digital literacy practices during touchscreen time

After discussing the general language exposures during touchscreen activities, more specifically, each child's digital literacy (Marsh, 2019) practices during their touchscreen time will be discussed below. All the children in my study used various apps that were designed for developing specific literacy skills in one or both languages at varied levels. As discussed in Chapter 2, studying children's digital literacy here means not only studying the traditional reading and writing literacy skills but also understanding the children's multimodal meaning-making practices during their touchscreen time. The proximal processes including both interpersonal communications and non-human interactions with the touchscreen are discussed below.

5.4.1 General language practices during touchscreen time

In the bioecological model, the change of time can influence the change of proximal processes (Bronfenbrenner & Morris, 2006). As the three mediagrams demonstrate the change of time during the data collection period, proximal processes, such as children's engagement with touchscreen activities and language practices during these

activities, may also change. Looking through the three mediagrams in each case study, while the uses of apps changed greatly during the data collection period for some children, their oral language use and habits remained stable and similar to their language practices in daily life. For example, in Tutu's case, she communicated with her parents in mostly Chinese and sometimes interwoven some English words into the Chinese sentence when speaking. In her touchscreen time, Tutu downloaded mostly apps in English. When looking into some conversation clips of Tutu's parent-recorded videos, she maintained a similar style of language utterances when playing these English apps (see *Quotes 4.4.20 and 4.4.23*). Similarly, for Moe, English was the dominant language she used to communicate daily, and she also spoke only English when playing most of the English apps (see *Quotes 4.3.24, 4.3.28*). Oral Chinese was only used by her mother when she sometimes accompanied Moe during her touchscreen activities, such as video calling Moe's Chinese grandmother together.

Apart from the oral language practices, for some children, the written language exposure and their bilingual/multilingual practices during touchscreen use, changed during the data collection period. With some newly added touchscreen apps during their touchscreen use, some children's written language practised during their touchscreen time also changed. For example, Mango's mother downloaded *iHuman Chinese* after the second interview for him, which later became his frequently-used app. Mango developed his Chinese reading and writing skills within this app; he used his fingers to write on the screen and learnt to write some Chinese characters in this app (see *Quote 4.2.18* and *Quote 4.2.21*). Similarly, Wangwang's mother also downloaded two more English e-book apps by the time of the third interview to help Wangwang learn more English reading and writing skills using these English reading apps. As we can see from the examples, the added written language exposure and practices during touchscreen use were mainly introduced by the parents, with some expectations for their child's literacy development.

5.4.2 Parent-child interactions through touchscreen use

One big difference in these children's touchscreen language practices was the amount of parent-child interaction during their touchscreen use. For some children, such as Feifei and Wangwang, intensive parent-child interactions were found during their touchscreen use since the parents always accompanied their children's touchscreen engagements. For children in early childhood, parent-child interactions are primary for children to foster attachment and close relationships within their immediate environments and facilitate multiple development (Bronfenbrenner, 1989, 2005). Compared to the co-watching of TV, the co-use of tablets may lead to parent-child interactions with higher quality (Skaug et al., 2018). When parents interact with their children and provide support during their co-use of apps, scholars believe that it can aid in the child's language development and their understanding of the subjects covered in the apps (Sheehan et al., 2019). With the multimedia effects, iPad apps may foster a closer bond between parent and child during the co-playing activities, which could have a beneficial impact on the language development of the child (Mifsud et al., 2021). From a bioecological perspective, the co-playing activities involve interpersonal interactions between parents and children in their family environment and the interactions between the developing person and touchscreens (Bronfenbrenner & Morris, 2006), which may together facilitate a child's development of language and digital literacy. Similar findings on the special benefits of using a touchscreen are reported by Feifei's father and Wangwang's mother. For example, Wangwang's mother played the piano app together with Wangwang and developed their music knowledge together while forming intensive parent-child interactions in mainly Chinese (see *Quote 4.6.31*). In Feifei's case, she liked her father's accompaniment when using touchscreen apps and often formed conversations with

her father during her touchscreen time in Chinese (see *Quotes 4.1.24* and *4.1.26*).

As children grow older, proximal processes can progressively become more complex, and children can interact with more other people during various activities (Bronfenbrenner & Morris, 2006). For Vicky, although her parents did not accompany her touchscreen use, she always shared her touchscreen time with her elder brother. The communications between siblings during the touchscreen time may also be fostered, but no intensive sibling communications were found in the collected data. The language choices of these families in their children's touchscreen time remained similar, as discussed in the section on FLPs.

5.4.3 Digital role-play and responsive touchscreen

Unlike the three children we discussed in the above section, for other children like Mango, Moe, and Tutu, they often played using touchscreens independently. Therefore, fewer parent-child interactions appeared during their touchscreen use. However, the lack of parent-child interaction did not mean that their language practices were few and limited; another form of interaction appeared in these cases. Instead of interacting with people, proximal processes also include the interactions between the developing person and objects (Bronfenbrenner & Morris, 2006). For example, children can form imaginative conversations and practise oral languages with the touchscreen and app contents. Like interpersonal interactions, considering the multimodal and responsive features of the touchscreens (Dowdall, 2019), the interactions between children and touchscreens should also be viewed as bidirectional (Bronfenbrenner & Morris, 2006). Meanwhile, without other people's presence, the developing child can play an active role in influencing the directions of their interactions with objects and symbols (Bronfenbrenner & Morris, 2006), in my study, touchscreen apps.

One obvious example is the digital role play (Fleer, 2017) of Moe when she played some apps (see *Quote 4.3.28, Quote 4.3.29*). Digital devices can provide cues and assistance that spark children's creativity in engaging with virtual environments or scenes, leading to digital role-playing (Fleer, 2017). For Moe, engaging in digital role-play through apps offered her a chance to practise and improve her spoken English, by creating imaginary dialogues with the virtual characters in the apps. Similar digital role-play engagement examples can be found in Tutu's case (see *Quote 4.4.19*). Tutu formed an imaginary conversation with a virtual character when 'feeding' the character food by moving her fingers on the screen; meanwhile, she also communicated with her mother while playing this multimedia app. In Mifsud and his colleagues' study (2021) exploring the co-reading of digital books in Maltese-English families with bilingual children, the scholars pointed out that the interactive nature of well-designed reading apps and the responsive operational settings of touchscreens fostered children's interests in engaging with these multimedia resources repetitively. Similarly, the digital role-play and imagination conversations that took place in Moe's and Tutu's home touchscreen uses were also closely related to the responsive and interactive designs of touchscreens and apps. It could also be seen from the examples mentioned above that, for Tutu and Moe, who formed digital role play and imaginary conversations during their touchscreen use, their oral language utterances remained similar to their language use in daily communication.

Moreover, in Vicky's case, despite the communication with her brother, a more frequent interaction happened between her and the AI chatting robot *Siri* when she wanted to play iPad without her mother's permission (see *Quotes 4.5.25, 4.5.28, and 4.5.29*). However, *Siri* could not process information when Vicky spoke with translanguaging contents in both Chinese and English. As the examples in Vicky's case study demonstrate, although Vicky sometimes spoke both languages during her

interactions with this chatting robot, she could only get ideal responses when she spoke full and complete English sentences. As discussed in Vicky's case study, *Siri* did not have the linguistic flexibility to fit the needs of a bilingual child and can only process one language at a time. This feature may limit Vicky's bilingual practices and force her into monolingual language use through her interactions with *Siri*.

5.4.4 Multimodal meaning-making processes

As mentioned in the above section, the digital role-play of Moe and Tutu, and Vicky's digital literacy practice of talking to *Siri*, were achieved through engagement with interactive and responsive touchscreen apps. Different from those three young girls, as an older boy, Mango did not foster digital role play. Instead, Mango was attracted by the user-friendly and entertainingly responsive features of the app called *iHuman Chinese*. As seen in the examples in *Quotes 4.2.18 and 4.2.20*, Mango was interested in the animation and sound effects of this app, and he spoke each time when the animation changed. He also got excited when he saw a bonus star on the screen after he finished a task. Using this well-designed app with multimodal effects fostered Mango's development of digital literacy; he focused on learning Chinese characters through these multiple modes (Erstad & Gillen, 2019).

Studies pointed out that children needed to acquire multiple modes and build both traditional literacy skills and digital operational skills during their digital literacy practices (Marsh, 2016; Poveda, 2019). When using devices such as mobile phones and touchscreens, children's digital literacy practices have multimedia and multi-sensory features (Marsh, 2019). As seen in the example *Quote 4.2.18*, with the animation and sound effects on the screen, Mango followed the visualised instructions and moved his fingers to write a Chinese character stroke by stroke. Each time he finished writing one stroke, the background voice would say the Chinese name of the stroke he just wrote. Similarly, when he finished writing all the strokes of this Chinese character, one virtual character of a bear appeared on the screen and encouraged him with some sound and animation effects. In this example, Mango's multimodal meaning-making process was clearly demonstrated. He used his fingers to demonstrate his digital operational skills, and with the instructions of the background voices and the changing of animations and screen layouts, he learnt to write a Chinese character during the process.

These multimodal effects, such as sound and animation effects and the changing screen layouts, work in a collaborative way to facilitate a child's digital reading and writing activities (Dowdall, 2019; Mifsud et al., 2021). Like the example in Mango's case mentioned above, Feifei demonstrated similar digital literacy experiences. In *Quote 4.1.26*, Feifei listened to the background audio of a question in Chinese while looking at the screen. She then answered the question in Chinese by reading out the sentence that appeared on the screen. Then the in-app recorder played the audio of Feifei's answer with animations of smiling faces that suggested Feifei answered the questions correctly. Similarly, in Wangwang's case, looking into examples of *Quote 4.6.21* and *Quote 4.6.23*, Wangwang used his fingers to operate the animation effects on the screen to answer the questions that background audio or the animation on screen layouts proposed. During this process, he listened to and read questions in English, he spoke both Chinese and English from time to time when playing this app.

Studies have found that 0-8-year-olds could benefit from their home digital use, since multiple skills could be facilitated during their digital literacy practices, such as STEM skills, socio-emotional abilities, and early language and literacy skills (Soyoof et al., 2024). In addition, children's agency can be enacted during these interactions with touchscreens with immediate feedback and turn-taking designs, for example, children

able to control the touchscreen independently and manage the paces of touchscreen activities (Peebles et al., 2018). Their agency also facilitates the children's varied developmental outcomes (Kucirkova, 2019; Russo-Johnson et al., 2017), for example, developing oral language skills. As the examples above demonstrated, for both Feifei and Mango, their literacy skills of reading and writing were practised within apps in Chinese. For Wangwang, instead of developing literacy skills, he mainly developed one of his STEM skills while engaging with his frequently-used app, *Todo Maths*. For the three children, they all demonstrated their positive attitudes when engaging with touchscreen apps, and they felt encouraged and motivated by some responsive and interactive designs of multimedia effects (Mifsud et al., 2021; Farrugia & Busuttil, 2021). Meanwhile, for all the families in my study, their language skills were practiced during their touchscreen digital literacy activities. For most of the children, their oral language skills in both their heritage language and English were practised, except for Moe, who mostly spoke in English.

Moreover, exploring more about the languages used during the children's touchscreen time, although Mango used this Chinese app to develop Chinese characters, he spoke only English when responding and commenting when engaging with this app with a Chinese background voice and interface in the examples (see *Quotes 4.2.18* and *4.2.20*). When discussing Mango's oral language use previously, he preferred to use mainly Chinese and sometimes both English and Chinese during family communication and in the interviews. However, as the oral language use of Mango in the two examples was mainly in English, it is possible that he subconsciously used his full linguistic repertoire when interacting with touchscreen, which was different from his language preference during daily family communication mentioned previously. Besides, the different oral language choices between the engagement with touchscreen apps and the daily family interactions also appeared in Wangwang's case. Wangwang communicated with his parents in both Chinese and English during their daily communication; however, when he played touchscreen apps, he preferred to speak in English when he played the app *Todo Maths* and got virtual sound and animation rewards on screen within this app (see *Quote 4.6.21*). However, as discussed in the parent-child interaction section, Wangwang's oral language use when he engaged with an app together with his mother was similar to his daily oral language practices. As for Feifei, when she played with some Chinese touchscreen apps, she used only oral Chinese when answering the questions and doing language exercises in these apps (see *Quote 4.1.24* and *Quote 4.1.26*).

As discussed in sections 5.4.3 and 5.4.4, the proximal processes of children's touchscreen activities varied. Each child engaged with touchscreen activities and apps differently, and this influenced their language development in different manners. As the PPCT model suggested, all the elements work together to contribute to a person's development outcomes (Navarro et al., 2022; Siraj & Huang, 2020). In each case, interpersonal interactions and the interactions between the child and touchscreen (proximal processes), devices and apps (techno-subsystem), the child's motivation, skills, behaviours, and the length and frequency of using touchscreens, are all variables that can influence their language and digital literacy development outcomes. In addition, the vital role of parents' characteristics in their children's touchscreen engagement will also be discussed in the following section.

5.5 Parental roles in family touchscreen use

As parents are the closest family members of these children and are key in their children's microsystems (Bronfenbrenner, 1994), it is vital to understand parents' roles and their impact on children's language and digital practice. Research points out that children's digital literacy practices are greatly influenced by their parental attitudes and

mediation strategies (Ozturk & Ohi, 2022). In heritage families, children's digital literacy practices are largely influenced by their parents' attitudes and meditations as well (Al Salmi & Gelir, 2024; Little, 2019; Soyoof, 2022). In Bronfenbrenner's (2006) bioecological model, the characteristics of both the developing person and the other people engaged in interactions influence proximal processes (Bronfenbrenner & Morris, 2006). In my study, apart from the vital role in influencing their children's general language choices (discussed in sections 5.1.2 and 5.2.1), parents also played a significant role in influencing their children's touchscreen use. The following sections will focus more on the influence of parental beliefs (force characteristics) and parental mediation strategies (resource characteristics) in children's multiple language development through their home touchscreen engagements.

5.5.1 Parents' attitudes and beliefs

Many studies have reported the significant influence of parental attitudes and beliefs on children's home touchscreen adoption; both benefits and concerns of the use of touchscreens are frequently mentioned in these studies (Chaudron et al., 2019; Ebbeck et al., 2016; Hinkley & McCann, 2018; Nevski & Siibak, 2016). The common concerns include the potential harm to the child's health, such as eyesight damage or addiction issues (Ebbeck et al., 2016); and the potential exposure to unhealthy or harmful contents (Bentley et al., 2016). In my study, similar worries about children's engagement with touchscreens have been mentioned by several parents. For example, Vicky's mother believed that Vicky sometimes could be addicted to watching videos on touchscreen since she always wanted to watch videos (see *Quote 4.5.23*). According to Bronfenbrenner's (2006) bioecological model, a person's active personalities (e.g., motivation and curiosity) can lead to the start and maintenance of proximal processes, but other beliefs, such as avoidance and concerns, may to some extent hinder these proximal processes (Tong & An, 2024). In my study, the different force characteristics of parents influence their children's touchscreen activities in varied ways.

These concerns mentioned above led the parents to form PM strategies, mostly restrictive ones, even for the parents who were open and positive about children's touchscreen adoption in my study. For instance, as a parent who gave the child freedom to play and explore touchscreens independently with the child's own touchscreen device, Tutu's mother also showed concerns regarding Tutu's eyesight and monitored her touchscreen time (see *Quotes 4.4.15* and *4.4.16*). In the case with most regulated touchscreen use, Wangwang's mother was strict on the contents that Wangwang could access; she disliked any violent, gaming, or other inappropriate contents (see *Quote 4.6.26)*. She said that touchscreens should only be used for Wangwang's learning and not relaxation; therefore, all the contents Wangwang could access must have educational meanings (see *Quote 4.6.20)*.

Apart from these concerns, almost all parents reported their beliefs on the benefits of applying touchscreen in their child's home life. The families of Tutu and Moe had the most positive parental attitudes and beliefs about the children's touchscreen adoption. Both mothers let the child explore the use of iPads and download apps as they liked. For the other families, they believed children's digital use can be vital and challenging at the same time (Kumpulainen & Gillen, 2019). One common benefit reported in my study was that all the parents believed that using some apps could be educational for their children, whether for their language development or for the development in other fields (e.g., maths, music). Language-wise, for Feifei, Wangwang, and Vicky, their parents believed that the use of certain apps facilitated the children's language development, either Chinese (in Feifei's case) or English (in Vicky's and Wangwang's cases). My findings align with some relevant studies that young bilinguals' languages can be developed with the help of online games or apps (Eisenchlas et al., 2016;

Harrison & McTavish, 2018), with parental support during their use of specific apps (Little, 2019).

Moreover, when looking into parental roles in facilitating their children's HL development through touchscreen, the parents of Tutu, Vicky, Moe, and Wangwang reported that they had limited HL touchscreen resources or found it hard to download apps in Chinese for their children. As it was discussed previously, the lack of HL touchscreen resources in heritage families could be related to personal reasons, such as the lack of technique skills to switch languages within an app or the lack of awareness to check the available language options for the app (Little, 2019). Some of the parents assumed that since they downloaded the apps from the UK app store, the apps should be in English rather than in Chinese. However, this was a misinterpretation rather than a fact. The fact was that for many frequently used apps of Moe, Tutu, and Wangwang, Chinese versions were available and could be accessed simply by switching the languages. This finding is also an example demonstrating how the resources of the parents (i.e., the digital awareness and skills) can influence the language practices of their children during touchscreen activities. For the Chinese parents of HL families, technical skills or awareness should be gained if they want to use rich touchscreen apps and resources to facilitate their children's Chinese development, as there are plenty of apps available in both simplified and traditional Chinese versions.

5.5.2 Parental mediations (PMs)

Different parental beliefs and attitudes about touchscreen adoption and language development may lead to varied PMs (Zaman et al., 2016). As mentioned previously, the PM strategies of the six families of children's touchscreen use were different; some were more restrictive and tighter, while others remained more freedom for the children to explore things during their touchscreen use. Scholars found that digital adoption among children under the age of eight is largely dependent on parental intervention and is frequently watched by parents, teachers, and caregivers (Livingstone et al., 2019). For children's home touchscreen use, parents and other family members always act as gatekeepers and significantly influence the young one's touchscreen experiences (Marsh et al., 2018; Siibak & Nevski, 2019).

Looking into the fourth column of *Table 3*, among all the cases in my study, restrictive mediation (Zaman et al., 2016) was commonly found; most specific methods lied on limiting the contents and time length of children's touchscreen. Active mediation and co-use (Zaman et al., 2016) strategies also appeared in all the families. Studies have found that in many families, active mediation and joint use of screens are consistently intertwined, creating a new PM strategy called participatory learning; parents sometimes use this strategy when they aim to develop digital literacy skills for their child or for themselves (Zaman et al., 2016). Similar findings were found in my study, the active mediation strategies and the co-use of touchscreens often appeared together in some families. In my study, during the participatory learning processes, parents often accompanied their children's touchscreen activities and sometimes co-explored and negotiated (Soyoof et al., 2024) the use of apps together with their children. For the families who always accompany the child's use of apps in my study, participatory learning can be found in many examples of individual cases. For instance, in Wangwang's case, his mother would always use apps with Wangwang together, especially when playing with educational apps, such as *My baby Piano* and *Todo Maths* (see *Quotes 4.6.21, 4.6.30, 4.6.31*). While fostering intensive parent-child interactions during these activities in mostly oral Chinese, the mother and Wangwang also explored and developed their understandings of some music and maths knowledge together during the processes.

Parents' various resource characteristics may influence how they apply these PM strategies. In Bronfenbrenner's (2006) bioecological model, resources of a person include their knowledge and skills (e.g., language and digital skills), previous experiences (e.g., their own experience of using technology and joint play), and other social or physical resources (e.g., purchasing specific apps/devices for their children) (Tong & An, 2024). In the cases of Mango, Moe, Vicky, Tutu, and Wangwang, distant mediation (Zaman et al., 2016) was applied. The distant mediation indicates the PM strategy that parents use to keep an eye on the child's activities when they maintain a distance from their children's use of media and let the children explore digital activities independently (Zaman et al., 2016). As seen from *Table 3*, some parents achieved distant mediation on their children's touchscreen use with the help of in-app timers and content filters with their digital skills; for Tutu and Wangwang, their parents also gave them a separate iPad and set up their children's accounts for them.

However, when looking into the PM strategies on language use during the children's touchscreen use, PM strategies on the children's language use in particular did not appear in all families. Studies have found that bilingual children's language and literacy development during digital activities are often related to the specific PM strategies on the use of languages (Haoning Mah et al., 2021; Sun et al., 2022; Soyoof, 2022). In my study, Feifei's father downloaded most of the apps in Chinese for Feifei to facilitate her HL development. Similarly, Mango's mother downloaded a Chinese app with similar language learning goals as Feifei's father. As for Wangwang and Vicky, some apps that can aid the English and maths development were applied in their home touchscreen use, which indicates more focus on the majority language and school performances of the parents. As for the other two families, Tutu's and Moe's mothers did not mention specific language mediations on the apps that the children use, and children's touchscreen activities in these two families were more entertaining, and the parents did not set specific educational goals during the children's touchscreen activities.

Some children may only use the dominant language during their touchscreen use, as the parents believe that this kind of monolingual digital literacy practice is vital and beneficial for their children's higher education and future development (Sun et al., 2022; Soyoof, 2022). However, different findings on PM of children's language use during touchscreen time in my study were found. For example, Wangwang's mother downloaded some e-books in English with specific educational aims to develop his English literacy skills. Instead of letting Wangwang develop English monolingually while playing these apps, she also translated between English and Chinese to facilitate his biliteracy development when using these English touchscreen resources (see *Quote 4.6.36*).

Moreover, if we look into non-digital and digital family language practices as a whole, some parents did mention PM strategies to aid their children's HL development through some non-digital activities. For example, Tutu's mother mentioned reading a Chinese picture book with Tutu. Feifei's mother and father would read books to Feifei in both Bahasa Indonesia and Chinese separately before bed. Moe's mother would teach Moe to pronounce numbers and sing children's songs in Chinese. Therefore, although limited PMs were found on using touchscreen resources to facilitate the children's language development in many cases, the parental role and mediations of facilitating the children's multilingual development should be stressed. Instead of viewing technology as a substitute for traditional language learning, it should be viewed as a supplementary tool (Hao, 2023). The use of a touchscreen is only one small part of a child's family life and language practices; more PMs and efforts to develop both HLs and English can be found in multiple non-digital activities and traditional family

language-learning activities.

5.6 Application of Bronfenbrenner's bioecological model in my study

As discussed in section 2.4, Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006) is the theoretical underpinning for my study. Based on my study findings, I explored how this theoretical framework can be applied to demonstrate the influences of various factors in facilitating a young child's development of both HL and dominant languages.

5.6.1 Process-Person-Context-Time in my study

While acknowledging the importance of all four defining properties in the bioecological model on a person's development (Bronfenbrenner & Morris, 2006), I explain each element and how the four elements work together (Navarro et al., 2022; Siraj & Huang, 2020) in my study (see diagram 2).

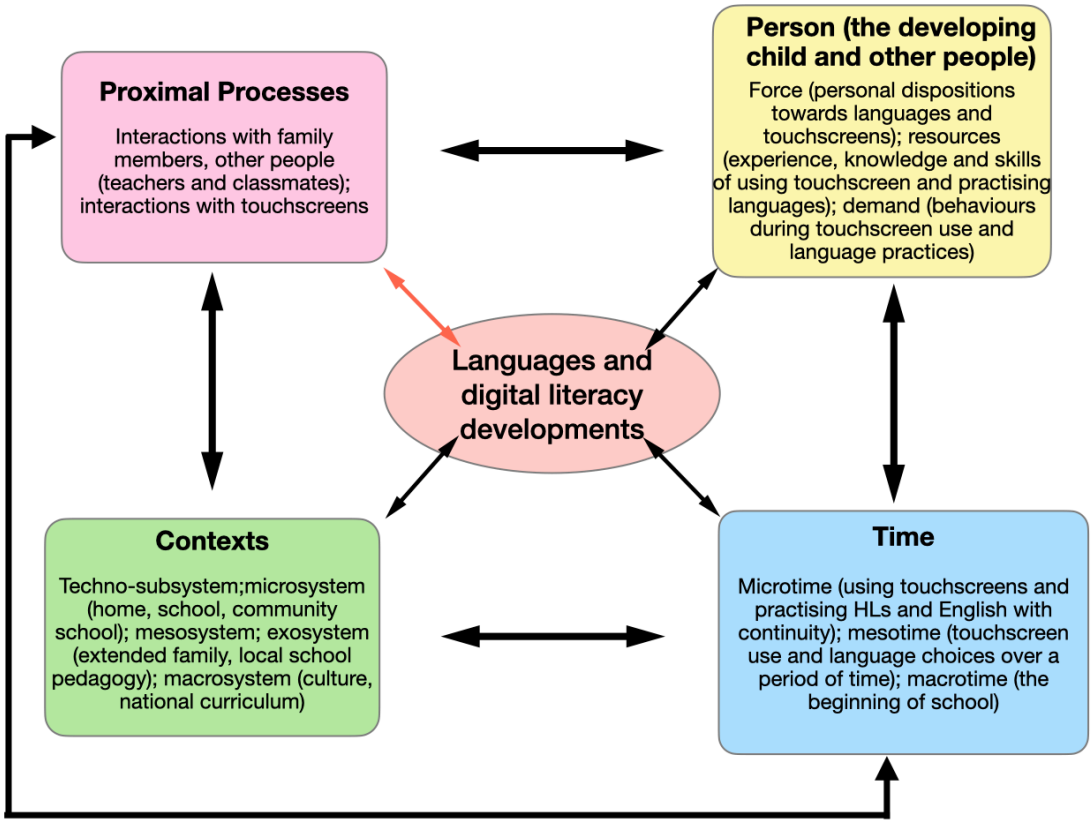

Diagram 2 PPCT model in my study

Proximal processes

In Bronfenbrenner's bioecological model, proximal processes are key to a person's development (Tong & An, 2024) (see the red arrow in diagram 2 to show the core importance of proximal processes). As explained in section 2.4.2, proximal processes are frequent and consistent bidirectional interactions between the developing person and their surrounding environments over an extended period (Bronfenbrenner & Morris, 2006). Proximal processes involve not only interpersonal interactions but also interactions with symbols and objects (Bronfenbrenner & Morris, 2006). In my study, both types of interactions and different proximal processes took place in these

children's engagement with touchscreens at home.

One common proximal process in my study is the interactions between children and their family members, mostly their parents. For early childhood children, parent-child interactions are vital to facilitate children's multiple developments and foster emotional attachments in the family environment (Bronfenbrenner, 1989, 2005). For bilingual children with heritage language backgrounds, the home environment and parent-child interactions are often an initial and primary way for them to develop and maintain their HLs. At later stages, as the proximal progresses gradually become more and more complex, a child can then engage with more people in their surrounding environments and participate in various kinds of activities (Bronfenbrenner & Morris, 2006). In my study, some bilingual children used different languages when interacting with different people (e.g., in the cases of Feifei, Mango, and Vicky). For example, a child may speak more English to her siblings and classmates while speaking mainly Chinese with their parents and remote relatives. Similarly, during children's touchscreen activities, interpersonal interactions involving two languages are also a common proximal process. For example, while the touchscreen app design was in English, a child may discuss the content of this app in both Chinese and English with their parents while playing the app (e.g., in Wangwang's and Tutu's cases). As the interpersonal interactions are bidirectional (Bronfenbrenner & Morris, 2006), a child may exchange their knowledge about languages and touchscreen use with other people, which leads to their development of bilingualism and digital literacy skills.

Another type of proximal processes is the interactions between a child and objects. These objects and symbols should be accessible in the developing person's immediate settings and have features to make the person curious and encourage the person to use their imaginative, operational, and illustrative capacities when engaging with the objects (Bronfenbrenner & Morris, 2006). Touchscreen devices are frequently integrated into bilingual children's family lives (Al Salmi & Gelir, 2024; Little, 2019; Mifsud et al., 2021), and the multimodal (Dowdall, 2019) and interactive designs of touchscreens can encourage children to explore touchscreen use. For a child who prefers to play touchscreen devices independently, interactions between the child and touchscreens facilitate their development of not only digital literacy skill but also language skills to some extent. For example, like in the cases of Moe and Tutu, some children may form imaginary conversations with the virtual characters in apps that they engage with (Fleer, 2017). Like the interpersonal interactions, the interactions between a child and touchscreens are also reciprocal (Bronfenbrenner & Morris, 2006). For example, while a gaming app gives instructions for the game through sounds and animation, a child may use their fingers to click on the right symbol, and then the touchscreen interfaces can respond and change accordingly (e.g., in Mango and Feifei's cases).

Person

The personal characteristics of the developing person greatly shape their proximal processes and further influence the person's development (Bronfenbrenner & Morris, 2006). As illustrated in diagram 2, the three key characteristics of a developing child (explained in detail in section 2.4.2) in my study are interpreted as follows:

Force characteristics: the dispositions of the developing child, their interests and motivations towards languages and touchscreen engagements. For example, if a child is motivated to develop their HL, they may actively interact with their parents in their HL instead of English. Similarly, if a child is interested in using touchscreens, they may spend more time exploring and operating these devices.

Resources: the experience, knowledge, and skills of using touchscreens and practising languages. For example, a child may use their equipped operational skills to play a gaming app independently. Or during interpersonal interactions, a child can use their

full linguistic repertoire and speak both languages to express their thoughts smoothly and clearly.
Demand characteristics: behaviours, appearance, and other features of a child that can positively or negatively influence other people's reactions during proximal processes. For example, a child may prefer to play on touchscreens independently and form few interpersonal communications with their parents.

The above three types of Person characteristics can significantly influence proximal processes (El Zaatari & Maalouf, 2022). A child plays an active role in their development, especially during their interactions with objects without other people's presence (Bronfenbrenner & Morris, 2006). In addition, when looking into the bilingual children's language and digital literacy practices in my study, parents' characteristics often play a vital role in mediating their family language choices and their children's touchscreen use. For example, parents' attitudes and beliefs (forces) may lead them to specific parental mediation strategies (resources) for their children's language development. More about the vital influence of parents will be explained in the section of the microsystem below.

Context
As illustrated in diagram 2, I structured the contexts of a bilingual child's language and digital literacy development into different layers. The techno-subsystem (Johnson & Puplampu, 2008) includes all kinds of touchscreen devices, such as iPads, mobile phones, virtual voice assistants, and smart watches. The microsystem (Bronfenbrenner, 1994) involves the immediate environments of a bilingual child, namely home, school, and weekend community school. In the mesosystem, I discuss how the microsystems interrelate with each other (Bronfenbrenner, 1994). The exosystem (Bronfenbrenner, 1994) includes extended family and local school pedagogy, and the macrosystem (Bronfenbrenner, 1994) refers to the societal culture and national curriculum. The details of how each system interacts bidirectionally with others and influences a child's bilingual development are discussed in 5.6.2.

Time
In the bioecological model, time is introduced as the fourth defining property for a person's development (Bronfenbrenner, 2005). As mentioned previously, an effective proximal process must take place constantly and frequently over time, it is vital to understand the influence of Time from three dimensions (Bronfenbrenner & Morris, 2006). As illustrated in diagram 2, in my study, microtime refers to children's specific touchscreen activities and bilingual language practices on a regular basis during their home environments. Mesotime is how children engage with touchscreens and practise HLs and English over a period, for example, every week or every month. The macrotime is related to the changing events or expectations. According to my study findings, the most significant change of event that can influence a child's bilingual development is the beginning of formal school (e.g., in the cases of Mango, Tutu, Vicky, and Wangwang).

Moreover, based on the explanations of the PPCT model (see section 2.4.2) and my research findings, a child's bilingual and digital literacy developments can be influenced by the cooperation of all four elements (Navarro et al., 2022; Siraj & Huang, 2020). Proximal processes, such as parent-child interactions, children's independent engagement with touchscreens, and interactions with remote families, are the key to a bilingual child's language and digital literacy developments (e.g., in Feifei's case). These proximal processes are shaped by the characteristics of the developing child and other people of these interactions, the real-life contexts where all kinds of interactions take place, and the time at three different levels (Bronfenbrenner & Morris, 2006). Similarly, as the double arrows in diagram 2 show, various proximal processes

keep evolving and gradually become more complicated, and in turn, may change the characteristics of Person, Context, and Time (Bronfenbrenner & Morris, 2006). For example, a bilingual child used to speak mainly their heritage language with people (proximal processes) at home and at playgrounds outside (Context); after starting nursery for a while (change of Time and Context), they developed more English skills (change of Person characteristics) and chose to communicate with people in more English (progressive complex proximal processes) at playgrounds and nursery.

In addition, as explained in section 2.4.2 (see the double arrows in diagram 2), the four defining properties and development outcomes also form bidirectional relationships (Bronfenbrenner & Morris, 2006). For example, a child's language development outcomes can be influenced by their motivations and persistence and their parents' involvement (Person), where (Context) and how regularly and frequently (Time) they engage with this language (Process). For example, Feifei developed her Bahasa Indonesia as she was willing to learn that language, she practised this language during daily communications with her mother and video calls with her grandmother. In turn, building on more and more language development outcomes, a child is equipped with more language skills (change of Person characteristics), and then they may spend more or less time (change of Time) to practise this language with different activities (more complex processes) in different scenarios (change of Context). For example, in Tutu's case, she developed better oral English skills after attending nursery for a while and engaged in more English during communications with her parents compared to before going to nursery.

5.6.2 A closer exploration of the relationships between Context and Person

After discussing the key elements of the bioecological model across my case studies, I illustrate how the PPCT model fits into my study as above. Then, I present an adapted model in diagram 3 to closely investigate the relationships between Person and Context on a child's bilingual development in my study context, focusing on the specific developments of both languages. I also try to illustrate the processes of digital literacy practices through the theories of Green's 3D (1988) model and Colvert's (2015) model that were analysed in Marsh's (2019) study of children's digital literacy.

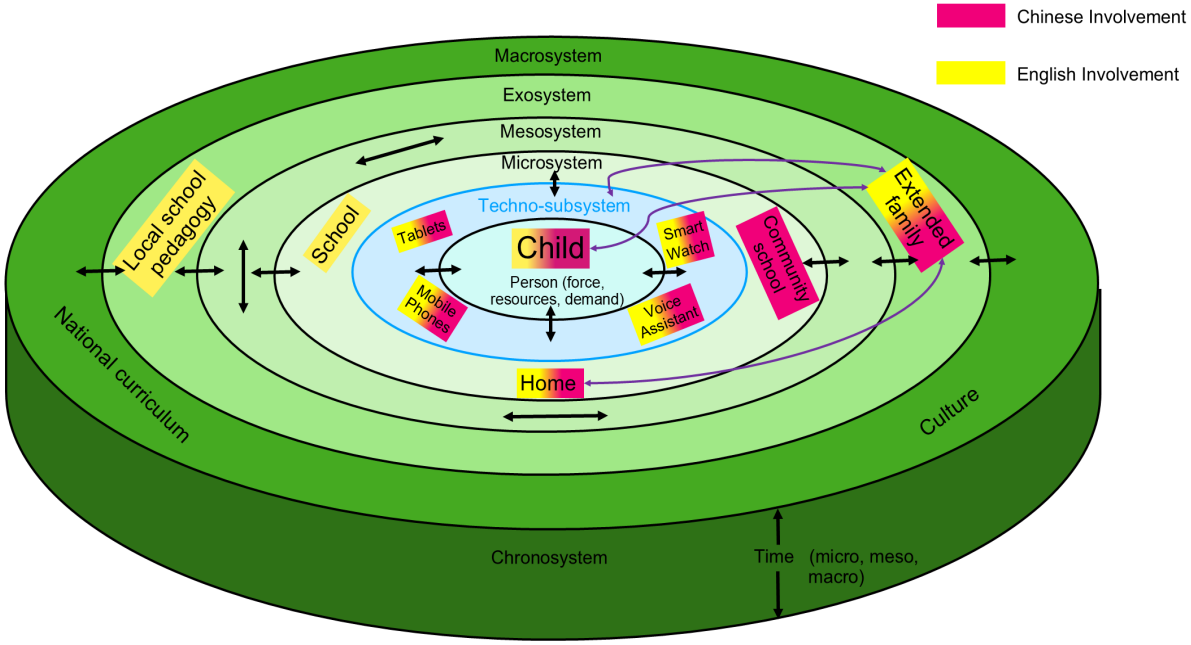

Diagram 3 Adapted Bronfenbrenner's bioecological model on children's bilingual

development

Child in the middle

In this adapted model, the child is in the centre to illustrate the vital influence of the active role of the developing child's characteristics (Bronfenbrenner & Morris, 2006; El Zaatari & Maalouf, 2022) on their own bilingual language development. For example, the child's age, motivations, language attitudes, their linguistic repertoires, and digital skills all belong to this category. When investigating children's family language choices, children's agency (Shen & Jiang, 2023) and active role in responding and adjusting to the language plans set by the parents should be stressed (Little, 2023; Roberts, 2023; Wilson, 2020). For instance, a child's positive attitudes towards HL maintenance can influence the FLP primarily set by the parents with an inclination to English (e.g., Mango set 'Chinese-only' rules at home). Meanwhile, the importance of a bilingual child's unique and fluid linguistic repertoire (Wei, 2018) should be acknowledged as an internal factor influencing their language practices.

Techno-subsystem

For all the children in my study, touchscreen activities were part of their family life. Johnson and Puplampu (2008) argued that a techno-subsystem should be embedded within the microsystem to illustrate how children form interactions with people and non-living digital tools while engaging with digital devices in immediate environments. Various proximal processes take place in each child's case, which benefits to better examine a child's developments compared to concentrating on one proximal processes (Bronfenbrenner & Morris, 2006). In my study, children's diverse home touchscreen activities and engagements provide a space for them to develop both languages through interpersonal communications with family members and interactions between the child and touchscreens. Therefore, I include this techno-subsystem in my framework, with a modification. Instead of investigating all kinds of digital devices, I focus on children's touchscreen use specifically, considering the multimodal and interactive features of these devices (Ozturk & Ohi, 2022; Farrugia & Busuttil, 2021). I included all kinds of touchscreen devices, such as tablets (e.g., iPad), mobile phones, virtual voice assistants, and smart watches. A child may practise and develop their digital literacy in various ways when engaging with touchscreens through multiple proximal processes. In my study, while intensive parent-child interactions and bilingual language practices during children's touchscreen activities (Al Salmi & Gelir, 2024) were found in some cases, other children also practised their languages during their independent touchscreen time through digital role play with virtual characters (Fleer, 2017) or communications with voice assistants.

During children's engagement with various touchscreen resources, how they develop digital literacy in both languages should be investigated. Building on Green's (1988) 3D model, Colvert's (2015) model explains the dynamic processes of how children engage with digital texts in four stages that are influenced by the three dimensions. The four stages are: design, production, dissemination, and reception (Colvert, 2015). In the operational dimension, a child can choose touchscreen devices and apps (design), then use the chosen resources to create contents (production) and share their work through digital platforms (dissemination). They may also receive feedback from their audiences (e.g., family members) and form interactions related to their touchscreen use (reception). In the cultural dimension, a child may consider their own cultural and life experiences when choosing apps (design) and creating digital contents via touchscreen (production), they may share their work on platforms (dissemination) with audiences who have similar cultural backgrounds and appreciate their expressions (reception). In the critical dimension, a child may carefully think about their intention of choosing a particular touchscreen activity or app (design) and examine if they create the contents that they intend to, then they also consider if certain platforms

are proper to share their work (dissemination) and may critically reflect and discuss the feedback with people around them (e.g., parents and siblings) (reception).

In terms of languages used and developed during children's touchscreen activities, factors in all three dimensions (Green, 1998) can influence children's decisions on developing their bilingual digital literacy. Based on my research findings, first, in the operational dimension, a child may choose and follow the language settings in apps to meet the needs of interacting with apps. For example, Wangwang followed the maths app instructions in English and practised his oral and written English skills. In the cultural dimension, a child may choose languages during touchscreen time according to their FLPs and cultural values on HL. For example, Tutu 'fed' a virtual character food while speaking Chinese, based on her own experience of speaking Chinese with her parents during daily activities such as eating. In the critical dimension, a child may also choose languages to reflect their critical thinking on how to use different languages to better interact with touchscreens and family members. For example, after some trial language use of both English and Chinese, Vicky spoke to Siri in one language instead of two to make the voice assistant successfully process her instructions. For bilingual children, their digital literacy practices during their touchscreen use can also be influenced by factors in different dimensions at the same time. For instance, when a child has limited HL app resources and needed to follow the app instructions in English, they may be flexible on their oral expressions in both languages based on their emotional and cultural values of HL when forming interpersonal or non-human communications during touchscreen activities, they may also adjust and practise languages in a different way to better engage with the touchscreen activities.

Moreover, a child's actual digital literacy development in different languages is complicated; it should be understood not only from the three dimensions that influence a bilingual child's literacy practices but also from how specific sociocultural factors in different layers affect their varied digital literacy practices (Marsh, 2019) in different languages.

Microsystem

In the microsystem, the most intimate and close surroundings that directly influence a child's development are included; how proximal processes take place during these immediate environments should be emphasised (Bronfenbrenner, 1994). Home, school, and community school are the most immediate environments in which a child develops languages directly. Home environments (with parents, siblings, and family members who live together) were the most crucial factor that influences a bilingual child's language development in immigrant families (Paat, 2013). Parents often actively engage with their children's heritage language maintenance in the microsystem through parental mediation or intensive parent-child interactions (MacLeod et al., 2024). As illustrated in diagram 2, when proximal processes involve interpersonal interactions, other people's Person characteristics also influence the proximal processes (Bronfenbrenner & Morris, 2006). For example, a parent's attitudes (force) towards languages and touchscreens may influence their ways of communicating with their children or choosing appropriate apps (resources and demand). Compared to other systems, HL is mostly practised within the home environment. For all the children in my study, both their HL and English were practised with parents and other family members (e.g., siblings) at home through varied FLPs.

Apart from the influence of parents' characteristics on their children's bilingual development, parents also actively affect the proximal processes of children's touchscreen activities. When looking into the relationships among the child, the techno-subsystem and the microsystem, home is the place where most of a child's touchscreen activities took place in my study. Touchscreen apps and resources can

be regarded as a space for a bilingual child to practise languages through both interpersonal communications and their engagement with interactive screens (Bose et al., 2023). Different FLPs and parental mediation (Soyoof et al., 2024) on children's touchscreen use lead to varied bilingual language exposure and practices in individual cases (Sun et al., 2022). As some parents may report a lack of HL resources, developing their digital skills to engage with rich touchscreen HL resources can be a useful way to enhance children's HL development (Ozturk & Ohi, 2022; Al Salmi & Gelir, 2024).

For the other microsystems, in my study, five out of six children went to nursery or school, and with only English exposure at school environments. These changes of Time and Context influence the developing child's proximal processes related to language activities and their further language developmental outcomes (Guo & Lee, 2023). While spending a large amount of time at school, formal schooling facilitated their English development while decreasing the time and energy for developing HL. The influence of community school was not as significant as the family and formal school environment; only two children in my study went to weekend community school, where they developed Chinese language and literacy skills. Although school and community schools in my study did not involve touchscreens in their teaching, they may still offer information about touchscreen resources for children to practise language at home. For example, schools can provide information on app resources to facilitate English and maths development at home (e.g., in Vicky's and Wangwang's cases).

Mesosystem

In the mesosystem, the interrelations between two or more microsystems should be investigated (Bronfenbrenner, 1994). In my study, I focus on the relationships between home and school and their influences on a child's bilingual development. Specifically, I investigate how HL maintenance is influenced by the mainstream educational needs in English. Like many studies, the finding in my research suggested a dilemma to maintain HL while pursuing academic achievements. Bearing in mind that the relationship between home and school should be bidirectional (Bronfenbrenner & Morris, 2006), how schools can create more inclusive environments to meet the needs of HL maintenance should be considered. Meanwhile, while recognising the vital role of community schools in facilitating children's HL literacy development (Liang & Shin, 2021; Shen & Jiang, 2021; Wang, 2023), sufficient supports from parents at home are necessary. Lack of parental support and assistance with children's HL homework in community schools may cause frustration and resistance to further develop HL (Huang & Liao, 2024).

Exosystem

The exosystem includes factors that indirectly influence a child's bilingual developments (Bronfenbrenner, 1994), such as local school pedagogy and extended families. For all the children in my study, making video calls with extended families back in China is mentioned as one of the family touchscreen activities. Although their interactions with remote families may not be frequent for some children, this video call activity lasts for a period before and during the data collection for all the families. Therefore, it can still be viewed as proximal processes that influence children's language attitudes and practices subtly (Bronfenbrenner & Morris, 2006; MacLeod et al., 2024). With their unique linguistic repertoires, children may use both languages during communications with remote families. The local school pedagogy influences children's bilingual development as well. For all the cases in my study, local school pedagogies were implemented in English.

Macrosystem

When considering broader social and cultural contexts in the macrosystem (Bronfenbrenner, 1994), bilingual children's language developments are influenced by the national education systems and cultural beliefs. For immigrant families, while parents may want to pass their cultural beliefs to their children, the societal cultures may greatly influence a child's perception of language and culture through their interactions with school and peers as well (Paat, 2013).

Chronosystem

In the chronosystem, significant life transitions, major events, and societal changes throughout a child's life are emphasised (Bronfenbrenner, 1994; Guo & Lee, 2023). For example, the starting of school, which belongs to the macrotime level, is a vital milestone in a child's bilingual development. Over time, HL-speaking children may increasingly speak the mainstream language and lose some proficiency in HL (Little, 2020). Similarly, children's continuity of practising languages regularly on a daily basis (microtime) or playing touchscreen apps in their HL or English for a longer period (mesotime), may also influence their bilingual development (Bronfenbrenner & Morris, 2006). As in my study, these specific activities and proximal processes should be studied in specific situations with each family.

Overlapping and bidirectional systems

As mentioned in section 2.4.1, instead of viewing the ecological systems as nested and static, they should be viewed as overlapping, as these systems interact with and influence each other dynamically (Morgade et al., 2019; Neal & Neal, 2013). In addition, in the bioecological model, the relationships and interactions between systems should be viewed as bidirectional (Bronfenbrenner & Morris, 2006). On the one hand, the interactions between the developing child and other people and objects that they interact with are bidirectional; on the other hand, all these systems influence each other reciprocally (Bronfenbrenner & Morris, 2006). Each system in my framework has intersectional and bidirectional relationships and influences each other in terms of a child's bilingual language choices (see the black bidirectional arrows). For instance (see the purple arrows as an example), a child may make digital video calls (techno-subsystem) with remote family members back in China (exosystem), and this may influence the child's FLP and language practices within the microsystem, as well as their own emotions and perceptions towards HL (Person characteristics of the developing child). Conversely, the FLPs and child's characteristics can influence the child's language choice during the digital video calls (techno-subsystem) with remote families (exosystem) as well. In a word, children's bilingual development is complicated and influenced by the interactions among these bidirectional and intersectional systems, and the characteristics of the developing child and other people involved in their various proximal processes related to developing languages through time.

Languages within systems

In each system, I used different colours to highlight the involvement of HL (Chinese in pink) and the dominant language (English in yellow). The language involvement here indicates both language exposure and language practice of children. The mixed colours indicate the involvement of both languages in the related environment and interactions. Since my study mainly focuses on children's language experiences within the home environment, the languages involved in the macrosystem, and chronosystem are less examined. When viewing children's language involvements with the influence of child-internal factors, microsystem and exosystem together, a bilingual child's language development can be influenced by the cooperation of all the elements in the PPCT model (Bronfenbrenner & Morris, 2006), with different stress on HL and the dominant language in each individual case.

5.7 Additional methodological findings

Some of my methodology design may contribute to the field of conducting research with young bilingual children. First, conducting LP activities with these children can be a double-edged sword. On one side, LP activity plays a positive role in ice-breaking. Children show more passion and experience less tension when involved in exercise-based LP activities rather than in standard interviews (Tatham-Fashanu, 2021). For example, for the 5-year-old girl Vicky, she was quite shy at the beginning of the interview and expressed more about her language use after doing the LP. For younger children like Tutu, Wangwang, and Feifei, they all showed interest and participated in the LP activity positively. On the other side, for younger children (Tutu, Wangwang, and Feifei), they may not be able to engage with the full picture of LP activity. But considering its role as an ice-breaking activity and the potential benefits of gaining deeper insights into children's linguistic repertoires through this visualised process, LP activity should still be applied in early childhood studies (Tatham-Fashanu, 2021). Clear and understandable instructions should be given to younger children, and the instructions can be designed flexibly to better facilitate younger children's understanding and creativity.

Second, watching the parent-recorded videos together with each family during the following interview can be beneficial to creating more intensive communications. For example, when Tutu and her mother discussed the contents of a parent-recorded video when watching it together in the second interview, Tutu recalled and described some details of her touchscreen activity with the help of this co-viewing activity. Similarly, after watching a video of Mango playing a Chinese app, he explained more about this activity and gave an example of how he remembered a Chinese character with the help of this app. Therefore, co-viewing activity of the child's touchscreen use videos in the interviews is a useful tool to generate more topic-related interactions naturally, as children may recall and share more about their experiences.

Third, for the evolving mediagrams, the creation and adjustment of each mediagram is a team effort. Viewing the parents and children as co-researchers, every time when discussing and amending the mediagrams together, the family would have more space and chance to reflect on the child's touchscreen and language use. However, I spotted one potential drawback of using the mediagrams. Only the oral and written forms of different languages can be illustrated in the mediagrams, but it is difficult to use lines to show if the languages are interwoven together or used separately. I had been thinking about changing the line styles to show that characteristic; for example, use curved lines interwoven together to demonstrate the use of both languages. But too many designs of the lines may cause confusion and affect the explicitness of the mediagrams (Lexander and Androutsopoulos, 2021). I finally decided not to make the mediagrams more complicated, since the original purpose of introducing the mediagram was to show the child's complex use of languages and touchscreen apps in a simple and vivid way.

5.8 Summary

In this chapter of cross-case analysis, I discussed the six families' language choices, FLPs, the children's digital literacy practices, and the parents' role in their home touchscreen activities in a more holistic way. In the following final chapter, I will summarise the findings in line with the research questions before outlining my contribution to knowledge and recommendations.

Chapter 6. Conclusion and Recommendations

As limited research specifically focuses on understanding the language experiences within Chinese heritage families with children in early childhood and how their languages are practised and developed through family touchscreen activities, my study meets the call and tries to add more knowledge to this area. Briefly summarise, my research explored a group of young Chinese-English bilingual/multilingual children's home language practices in the UK and gained more in-depth understandings of their digital literacy practices during family touchscreen activities, with a focus on parental involvement. In this final chapter, specific research questions are answered in the following section to summarise my findings. Then, the research limitations, contribution to knowledge, implications, and recommendations for further study and HL families are discussed. Last but not least, I will end my thesis with some of my final thoughts about my PhD journey.

6.1 Findings

Based on the discussion of individual cases and the cross-case analysis, the findings of my study will be illustrated in this section in line with the three research questions.

RQ1: What is the general pattern of a young bilingual/multilingual child's home language choices?

Looking through the lens of the bioecological model (Bronfenbrenner & Morris, 2006), in my study, a bilingual/multilingual child's language choices and developmental outcomes are influenced by the collaborative work of Process, Person, Context, and Time (Navarro et al., 2022; Siraj & Huang, 2020). To understand the general patterns of the six young bilingual/multilingual children in a consistent and holistic way, I mainly discussed the relevant findings through the Family Language Policy (FLP) approach (Curdt-Christiansen, 2016).

When looking into the influence of Person characteristics (Bronfenbrenner & Morris, 2006) on these bilingual children's language development, both the characteristics of the developing child and their parents played vital roles. When studying children's maintenance of minority languages in society, parents often actively engage in language-related activities in the microsystem (home environment) to facilitate their children's language development (MacLeod et al., 2024). For all the parents in my study, they demonstrated positive attitudes (force characteristics of parents) towards helping their children maintain and develop their heritage languages (HLs) at home. Their HLs, especially oral Chinese, are practised in the families' daily lives, but to varied degrees. Based on different family situations, each family formed their own unique FLP.

Apart from the influence of parents' characteristics, the developing child often plays an active role in their own bilingual development (Bronfenbrenner & Morris, 2006). For example, children's emotional preferences towards languages (forces), their equipped bilingual skills, and responses to parents' initial FLP strategies (resources and demands), all influenced their actual language choices and practices at home. For example, Mango set 'Chinese-only' rules at home, and Vicky asked to go to weekend community school. Another finding related to the characteristics of the developing children is their translanguaging practice (García & Otheguy, 2020). For four children in my study, translanguaging commonly took place during their home language practices. Bilingual/multilingual children's linguistic repertoires should be viewed as unique and whole, and in a fluid state (Wei & García, 2022). Using their unique and fluid linguistic repertoires is one way to demonstrate children's motivations of practising both languages and resources of bilingual language skills and experiences. These

resources can facilitate their language practices and bilingual development in their daily proximal processes at home. The varied translanguaging practices in each family could be related to their FLPs as well. For the two children, both languages were used casually to meet daily communication needs, and translanguaging practices took place frequently (see Tutu's and Vicky's cases). However, for families with clear FLPs of using specific languages in their daily communication, translanguaging also took place but was not a significant feature (Mango's and Wangwang's cases). No obvious translanguaging practices were found in Feifei's and Moe's cases.

As discussed above, both characteristics of parents and children played a vital role in shaping and practising their FLPs (Shen & Jiang, 2023). The bidirectional parent-child interactions were found to be the primary proximal process for children to develop languages in all the cases in my study. For some families, they created more casual language use environments based on their actual communication needs; no specific language rules were applied (e.g., in Tutu's and Moe's cases). For other families, their FLPs changed over time for different reasons. According to the PPCT model, the change of Time and Context can greatly influence the proximal processes and a person's developmental outcomes (Bronfenbrenner & Morris, 2006). In my study, the change of FLPs and actual language practices in some families were influenced by the changing scenarios in their family as well.

One of the most common changing points that influenced these children's language choices and the alteration of their FLPs is the beginning of school and educational needs in formal school life. Entering school and formal education are major events in the chronosystem that continuously influence a person's development (Bronfenbrenner & Morris, 2006; Guo & Lee, 2023). The beginning of school/nursery may sometimes benefit the children's English development and reduce their HL language use (Little, 2019; Huang & Liao, 2024). For Tutu, Vicky, and Wangwang, entering school and nursery facilitated their English development and reduced their time of exposure to Chinese in their family environments. Different from their family environments, the consistent and regular interactions in English between these children, their teachers and classmates in the school environment added complexity to the proximal processes related to a bilingual child's language development. In the PPCT model, the relationships of the four defining properties are bidirectional (Tong & An, 2024), and along with the changing time and contexts, the characteristics of people involved in the processes may also change. For example, in Mango's case, the pressure for school entrance exams forced the parents to alter their oral language strategies when communicating with Mango, from mainly Chinese to both Chinese and English (changed motivations of parents), aiming to help him practise and speak English in correct grammar for better school results.

However, starting mainstream English school life did not mean the automatic reduction of HL development in my study. Instead, children's bilingual/multilingual capacities keep developing at the same time after entering school (see Tutu, Vicky, and Wangwang's cases). For two children in my study, apart from home and school, the weekend community schools also belong to the microsystems that facilitate their Chinese development. Apart from the interpersonal interactions with parents, siblings, teachers and peers, some children also practised their Chinese language skills through interaction with Chinese-monolingual relatives when these relatives visited their home. Proximal processes in other systems may also influence a child's bilingual development. I will discuss more findings about the other proximal processes involving the interactions between a child and touchscreens in RQ2.

RQ2: How does a young bilingual/multilingual child develop their digital literacy through touchscreen activities?

In my study, during children's touchscreen activities in their home environments, multiple proximal processes take place to support their development of both languages and digital literacy. For some children (Feifei, Moe, and Tutu), their language practices during their touchscreen time matched their language choices in other daily activities at home. For the other children (Mango, Wangwang, and Vicky), their oral language use during the touchscreen time sometimes differed from their daily family communication. Both interpersonal interactions, especially parent-child interactions, and interactions between the developing child and their touchscreen devices/apps were involved in these processes.

For the interpersonal interactions, according to my findings, some children's touchscreen activities were frequently accompanied by their family members (often their parents). For example, during the co-use touchscreen activities, intensive parent-child interactions (Sheehan et al., 2019) based on the app contents were found in Wangwang's and Feifei's families. Few interactions were found during the co-use of the touchscreen between Vicky and her brother. Like discussed in RQ1, the characteristics of each person involved in interpersonal interactions can influence the developing person's proximal processes and developmental outcomes (Bronfenbrenner & Morris, 2006). As my RQ3 is designed to focus on the role of parents in facilitating their children's bilingual/multilingual language development through touchscreen activities, I will discuss more about parents' characteristics when answering RQ 3 below.

In addition, with the help of touchscreen devices and apps (techno-subsystem), children in my study could interact with their extended family members (frequently their grandparents) who lived in another country (exosystem). Considering the bidirectional nature of these interactions among different layers of systems (Bronfenbrenner & Morris, 2006; Tong & An, 2024), children's bilingual development is influenced by this kind of activity as well. For example, as most of the grandparents in my study were monolingual speakers of their heritage language, children exchanged more knowledge in their heritage languages when communicating with their grandparents through video calls.

When looking into the influences of children's characteristics on their digital literacy and language development, all the children were equipped with knowledge and digital literacy skills (resources) to operate and engage with specific touchscreen activities. However, each child developed and practised their languages differently through their family touchscreen activities. The influence of children's characteristics varied in each study and needed to be viewed in a holistic way, considering the influences of the characteristics of other people, time and contexts as well.

In my study, children in some cases had more freedom to explore their touchscreen use, while other children experienced more restrictive touchscreen activities mediated mostly by their parents. When looking into the language exposures during these children's touchscreen use, oral English and Chinese exposures outweighed the written language exposures in all the cases. Although the types and amounts of touchscreen activities were different in each family, watching videos or cartoons was one common activity among these children. However, like the sedentary screen-viewing activity, watching videos on the touchscreen fostered fewer language interactions compared to other touchscreen activities.

When looking into the interactions between children and their touchscreens, normally without the presence or interference of parents or other people, a child actively demonstrated their agency (Kucirkova, 2019; Schlosser, 2015) and formed various kinds of proximal processes. Children's agency is primarily demonstrated when a child

operates a touchscreen device independently and forms physical interactions with the touchscreen (e.g., tapping and dragging) (Russo-Johnson et al., 2017). Then, the responsive and interactive features (Dowdall, 2019) of multimodal touchscreen devices (Marsh, 2019) and some well-designed apps helped them to practise their digital literacy and languages in a bidirectional way (Bronfenbrenner & Morris, 2006). In other words, with the help of turn-taking and immediate responses from touchscreen apps, children's agency facilitated their development of languages and other digital skills (Kucirkova, 2019; Peebles et al., 2018). For Moe and Tutu, they often formed imaginary conversations with the virtual characters in their apps, known as digital role-playing (Fleer, 2017). For Mango, he was attracted by the responsive nature of a well-designed language learning app and formed plenty of language utterances in English while using this Chinese app on his own. For Vicky, she frequently talked to the DVA *Siri* when the iPad was locked, but *Siri* could not process any of her translanguaging language use. Instead, she could only speak monolingually to communicate with *Siri* instead of fully engaging with her bilingual linguistic repertoire.

In addition, as explained in section 5.6.2, the interactive meaning-making processes during a child's touchscreen activities can be understood by applying Colvert's model (Colvert, 2015; Marsh, 2019). In my study, children demonstrated various digital skills in the operational dimension, especially during the stages of production and reception. For example, all the children could independently operate touchscreen devices with their fingers (production and reception), such as dragging items, drawing pictures, and taking photos. Less skills in the dissemination and critical stages were found in the six families in my study as in Marsh's (2016) study.

As mentioned above, various proximal processes took place during their touchscreen activities, and these proximal processes could change or evolve to more complex proximal processes over time (Bronfenbrenner & Morris, 2006), and facilitate their digital literacy and bilingual developmental outcomes. For the proximal processes to be effective, a child's engagement with touchscreens should be on a regular basis. For example, after entering school (macrotime), Vicky started using an educational app to develop her English and maths skills daily at home (microtime); she did exercises in this app throughout the data collection period (mesotime). She developed her English and maths skills through the interactions with the app and interpersonal interactions with her parents and older brother during this activity. Therefore, time also plays a vital role in influencing the levels of a child's digital literacy and language development through their engagement with touchscreens.

RQ 3: What is the parental role in facilitating their child's bilingual/multilingual language development through touchscreen activities?

From the bioecological perspective, parents play crucial roles in a child's multiple developments in their most immediate environment, especially for early childhood children (Bronfenbrenner, 1989, 2005). Like mentioned in RQ 1 when discussing how parents' characteristics influenced a child's general language choices, parents also played a vital role in supporting a child's language development while using touchscreens.

First, considering the resource characteristics of parents, all the parents were equipped with some basic digital skills and acted as gatekeepers (resources). They can provide and purchase touchscreen devices and apps for their children (Little, 2019). Purchasing apps, especially those well-designed apps with educational features, was common in some cases in my study. Second, parental beliefs on touchscreen and language (force characteristics) together lead to their multiple parental mediation (PM) strategies (Zaman et al., 2016) for the children's touchscreen use. For all the families, different PMs were used to facilitate the benefits and aid the potential risks of their

children's touchscreen use. Restrictive mediation and active mediation were found in all the families, while active mediation and co-use activities were combined in five families (except Mango). To perform different PM strategies, parents should be actively engaging with their own resources, equipped with specific knowledge and skills. For example, distant mediation strategies were applied in five families (all except Feifei). Parents used the features of well-designed apps and touchscreens to apply distant mediation, such as setting the in-app timer and content filters, child-protect accounts, and preparing individual touchscreen devices for the child.

Most of the PM strategies in the families focused on monitoring their children's touchscreen in general, such as the time length, contents, and gestures when using apps. However, not all the families paid special attention to the PMs on the language choices of apps that their children engaged with. In some families, parents downloaded more apps related to developing their children's English literacy skills. For example, in the cases of Vicky and Wangwang, they used different maths apps to develop their maths and English literacy at the same time.

For those parents who aimed to facilitate their children's HL development through touchscreen activities, they chose Chinese apps to facilitate their children's Chinese oral language skills and digital literacy through engagement with these well-designed apps (Feifei and Mango). Some parents even participated in the learning process and encouraged their children to develop language skills in either HL or English, through the parent-child co-use of some well-designed apps. However, some parents reported a lack of HL resources (Park et al., 2012) for touchscreen apps. For these families, the lack of resources could be due to a lack of awareness or technical skills (Little, 2019) to check and change the language settings in some apps that are available in Chinese.

What's more, the use of touchscreens is only a small part of a child's family life; parents' role in facilitating the young bilinguals/multilinguals' language development in other family activities should also be valued (as discussed in RQ1). Some parents in my study also reported multiple ways to help their children develop HLs through traditional activities, such as bedtime storytelling, singing children songs together, and reading picture books. Intensive parent-child interactions were mentioned when they talked about these non-digital family language activities. Therefore, although the touchscreen has its unique features and benefits to facilitate the young bilingual/multilingual's language and literacy development in various ways , it should not be regarded as a replacement for non-digital family activities (Hao, 2023).

6.2 Limitations

After discussing the main findings of my study, here are some shortcomings of my research design. My study identified fruitful findings on the general language choices and diverse digital literacy practices of these 3-7-year-old Chinese heritage children. But only limited knowledge on how they develop bilingualism in other non-digital family activities was obtained. This can be one of the limitations of my study. Another limitation could be related to my methodology design. As I adopted the case study approach, the findings of my study cannot be overgeneralised into bigger contexts. However, this can also be viewed as a strength since the case-study design helped me gain in-depth and detailed knowledge of the actual family language choices and digital literacy practices in the six families in England. In addition, considering parents as co-researchers and letting them record videos on their children's home touchscreen activities may result in selected contents. Being aware of this, I always analysed these video data with family interviews and mediagrams to form data triangulation (Little & Little, 2022) and increase the data integrity and trustworthiness (Flewitt, 2019).

6.3 Contribution to knowledge

After discussing the main findings and limitations of my study, I will discuss how my study contributes to knowledge in empirical, theoretical, and methodological aspects.

First, my study findings contribute to adding knowledge to about the language choices and children's bilingual digital literacy practices within Chinese heritage families in the UK context, with a narrow age group. When looking into the age group of my participants, children from 3 to 7 years old capture the stages from preschool to the beginning of formal schooling. The findings in each case study showed unique and vivid pictures on the touchscreen digital literacy practices of a child from Chinese heritage families in England. The cross-case discussion offered a chance to investigate the similarities and differences in the language choices and touchscreen digital literacy practices of these children in my study. In addition, by closely investigating these children's specific touchscreen activities in their real-life contexts, I presented extensive data in each case study to provide valuable insights into how touchscreen apps can support heritage language development. However, as my study took place only in their home environments and was small-scale case studies, while it provides a strong foundation, further research in this area is needed to expand our understandings in this research area.

Second, I made contributions to the theoretical aspect. Bronfenbrenner's bioecological model is argued to be a useful and detailed framework to explore research topics in international and intercultural education, and while a few studies have applied this model, limited research explained how this model is associated with their study in detail (Tong & An, 2024). To put this theoretical framework into real practice, researchers should examine the interactions/relationships between Person and Context across several groups, analysing and forming better understandings of how a development may evolve over time (Bronfenbrenner & Morris, 2006; Tong & An, 2024). In my study, I closely examined the applicability of Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006) to illustrate factors that influence a child's bilingual development. By applying the Process-Person-Context-Time model in my study context (see diagram 2), researchers can better understand the relationships among these bilingual children's (Person) language and literacy developments through touchscreen activities and other family activities (Process) within their home environments, while acknowledging the influence of other factors in different systems on children's language choices (Context) during the research data collection (Time). Looking into this application of the bioecological model (see diagram 3), the bidirectional interactions among different systems, interpersonal interactions and interactions between the developing child and touchscreen, the change of time, characteristics of the developing child and other people involved, can all be understood in a holistic way. In addition, Green's (1988) 3D model and Colvert's (2015) model that were illustrated in Marsh's (2019) research are also applied in this framework to discuss the multimodal meaning-making processes and digital literacy development during a bilingual child's touchscreen use.

Third, some of my methodological design may contribute to the knowledge of conducting research with young bilingual children. As discussed in the section of additional findings, doing the LP activity as an ice-breaking activity did help some of the younger children to relax and express their opinions on the research topics. Therefore, LP should be applied when doing research with children; easier and more understandable instructions should be formed and given to younger children. In addition, I introduced the co-viewing of parent-recorded videos into the interview processes to help children and parents reflect more on their touchscreen experiences and language practices. Apart from the specific methods I used during data collection,

my methodological design also demonstrates an innovative approach to exploring digital interactions and heritage education in family contexts. I compared the similarities of the two approaches and the unique strengths of each, and then combined both digital ethnography and the case study approach to better reflect on the complexity of these children's touchscreen and language experiences. On the one hand, digital ethnography (Pink et al., 2015) offers me a chance to obtain knowledge of children's touchscreen use in real-life contexts and the practical ways to conduct my fieldwork during the COVID-19 pandemic. On the other hand, the case study approach (Yin, 2009) provides me an opportunity to gain in-depth understanding of children's language and touchscreen experiences in specific heritage and family contexts. The case study approach also guided me to select an appropriate theory and structure my findings (i.e., Bronfenbrenner's bioecological model). This methodological design can enhance the credibility of the study and shed light on future research designs in this area.

6.4 Implications and recommendations

Based on my study findings and limitations that were discussed previously, some potential implications for parents, practitioners, and researchers will be discussed here. For heritage families, helping their child maintain the HL in an English-dominant society may be challenging (Huang & Liao, 2024; Liang & Shin, 2021). The experiences of the six children in my study may resonate with some other families in similar situations. As discussed above, some parents reported a lack of HL digital resources in the UK context, which may be due to a lack of awareness or digital skills (Little, 2019) to operate the language options of apps instead of lacking apps available in Chinese. It is fundamental for parents to foster their awareness to find proper apps in HL for their children. They need to recognise the unique responsive and multimodal features (Marsh, 2019) of touchscreen apps in benefiting their children's development of literacy (Mifsud et al., 2021) and other skills. More supports should be given for the parents to develop better knowledge in using touchscreen resources (Hao, 2023; Ozturk & Ohi, 2022) to enhance their children's HL digital literacy experiences. Based on my findings, there are some tips for parents to better use touchscreen apps and resources to facilitate their children's HL practices. Some necessary skills and strategies are listed below.

First, parents need to develop knowledge and digital skills for finding appropriate apps for their children and switching languages. For example, they can download apps in the UK app store by searching for the key words (e.g., Chinese) and refining the age group. For apps that are available in several languages, some of the language settings are inside the apps, and others need to be switched from the device system settings. Parents also need to value children's voices and tailor their app use based on children's interests and HL development needs.

Second, parents should consider how to engage more with their children's touchscreen activities and how to better support their children's digital HL practices. For example, in my study, participatory learning, which includes active mediation and co-use activity, is a useful mediational tool for some parents to engage and participate more in their children's touchscreen activities.

Although parents' scaffolding and assistance can be vital during children's touchscreen use, parents should also give space and let the child develop their HL and English capacities independently with some well-designed apps. According to my study, when some children played apps alone, some intensive and creative bilingual digital literacy practices took place. Parents can use distant mediation to minimise touchscreen safety issues when letting the child think and develop their digital literacy skills independently.

Third, as some parents in my study mentioned, they often facilitated their children's HL use through a variety of non-digital activities. These non-digital activities in the young bilinguals' family life can also be beneficial and should be maintained when engaging with more digital activities. However, how to combine both traditional non-digital activities and touchscreen use in a young bilingual's family life to better facilitate their language and literacy development needs more consideration. Further research should be done in this area.

For ECEC practitioners in the UK context, although most of the language practices in school are in English, it is vital to acknowledge and respect the unique bilingual repertoires of bilingual or HL-speaking children in classroom environments (Wei & García, 2022). As seen from the case studies above, some HL-speaking children showed positive attitudes and agency (Shen & Jiang, 2023) to keep developing their bilingual literacy, especially practising their HL skills, after starting formal education in England. Therefore, it is vital for practitioners to consider how to build up the multilingual bridge for these HL students in classroom and help these children maintain their bilingual identity and develop both languages. For instance, teachers could embrace more translanguaging pedagogies to support the development of bilingual children's whole linguistic repertoire (Wei & García, 2022).

As discussed above, my study shed light on understanding the real-life experiences of six Chinese-English bilinguals' home language use and their diverse touchscreen literacy practices. My study focuses on the home language practices of these young bilinguals, but school life and language use at school are also big parts of some of the children's lives. Further study should explore young bilinguals' language use and touchscreen practices in both home and school settings to better understand and give suggestions to help them maintain and develop their HL while developing their educational needs in the dominant language. Meanwhile, building on my study, both digital and non-digital home activities in these heritage families should be studied in detail. Further research needs to explore how to better combine both digital and non-digital ways to support children's bilingual development.

6.5 Final thoughts

My PhD study design was driven by both the research needs and my own interests. Being a Chinese-English bilingual myself, I belong to the same ethnic group as my participants, which is a strength for me. Speaking Chinese was welcomed if the families felt more comfortable expressing themselves in their HL. Although the recruiting process was not smooth at the beginning, and COVID-19 had made it more challenging, doing this study to pursue my PhD was a unique and meaningful experience for me.

Chapter 7. Bibliography

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Appendices

Appendix 1 Ethical approval letter

Downloaded: 19/01/2022
Approved: 19/01/2022

Kexin Cheng
Registration number: 200215118
School of Education
Programme: PhD Education

Dear Kexin

PROJECT TITLE: Young Chinese-English Bilinguals' Home Tablet Apps Adoptions and Literacy Development in England
APPLICATION: Reference Number 044270

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 19/01/2022 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 044270 (form submission date: 13/01/2022); (expected project end date: 26/10/2024).
- Participant information sheet 1099618 version 3 (13/01/2022).
- Participant consent form 1099619 version 2 (25/11/2021).

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Your responsibilities in delivering this research project are set out at the end of this letter.

Yours sincerely

Anna Weighall
Ethics Administrator
School of Education

Please note the following responsibilities of the researcher in delivering the research project:

- The project must abide by the University's Research Ethics Policy: https://www.sheffield.ac.uk/rs/ethicsandintegrity/ethicspolicy/approval-procedure
- The project must abide by the University's Good Research & Innovation Practices Policy: https://www.sheffield.ac.uk/polopoly_fs/1.671066!/file/GRIPPolicy.pdf
- The researcher must inform their supervisor (in the case of a student) or Ethics Administrator (in the case of a member of staff) of any significant changes to the project or the approved documentation.
- The researcher must comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data.
- The researcher is responsible for effectively managing the data collected both during and after the end of the project in line with best practice, and any relevant legislative, regulatory or contractual requirements.

Appendix 2 Information Sheet (English and Chinese version)

Participant Information Sheet

家长知情书

How do young Chinese-English bilingual children use tablets and learn languages at home?

中英双语孩子在家里是怎样使用平板电脑和学习语言的呢?

Dear Parent/extended family member (grandparents, aunts, etc.dependently),
亲爱的父母/其他家庭成员（祖父母，阿姨等等），

You are being invited to take part in an education research project. Before you decide whether or not to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information and discuss it with others if you wish. It will be very welcomed to ask me any questions you may have. Take time to decide whether or not you wish to take part. Thank you for reading this!
诚邀您参加一项教育学研究项目。在您决定是否参与这项研究之前，了解为什么要做这项研究和您在其中会参与哪些活动是很重要的。请花几分钟的时间来阅读以下信息，如果有需要也可以跟其他人讨论。如果您对这项研究有任何疑问，十分欢迎您来询问我。请花一点时间来决定您是否有兴趣参加这项研究呢？谢谢您花时间阅读本知情书!

Why doing this project?

为什么要做这项研究?

It can be observed in our daily life that young children use mobile phones, iPads and other touchscreens frequently at home. For example, to play games, or to watch cartoons. For young bilinguals who are between 3 to 6 years old, they are learning languages while using the tablets in their daily lifes. How they use tablets and the connections to language development is an new area worth exploring. Therefore, I designed this project as my PhD research topic, hoping to understand more about our young bilinguals' tablet use at home and how they learn to speak, read and write from a young age.
在我们的日常生活中，可以观察到越来越多的小孩子在家里频繁使用手机、iPad 和其他可触屏设备。例如，用这些设备来玩游戏或者看动画片。对于 3-6 岁的双语儿童来说，他们在日常使用这些平板设备的同时也在学习语言。那么，他们是如何使用平板电脑的，以及使用平板电脑与语言能力的发展之间的联系，成为了值得探索研究的新领域。所以，我设计了这项研究作为我的博士研究论题，希望能够深入了解双语儿童日常在家中的平板设备使用情况，以及他们是怎样在这样小的年纪来学习说话和发展读写能力的。

Why have I been choosen?

为什么选择我来参加呢?

First of all, thank you for contacting me and showing your interest in the project. You have been chosen because you and your 3-6 years old(s) are the ideal participants for the study. Another

5-7 families will join our project too, who are also Chinese-English bilingual families living in the UK, and who can also access tablet in their daily life.
首先，谢谢您联系我并且表明您对这项研究的兴趣。之所以想要选择您参与此项研究，是因为您和您的孩子（3-6 岁）是这项研究的理想人选。除您之外，会有其他 5-7 组家庭也加入我们的研究。我们的研究人选全部都是生活在英国的中英双语家庭，并且都可以在日常生活中使用到平板电脑等设备。

Do I have to take part?

我一定要参加吗？

It is entirely up to you to take part or not to take part in this research. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time without any negative consequences. If you wish to withdraw from the research, you do not have to give a reason, please contact me directly via email or WeChat.
是否参加此项研究完全由您个人来决定。如果您想要参与此项研究，那么您可以保留这封家长知情书（并且签署一份同意书）。您在签署后依然可以随时退出此项研究，不会产生任何不良的后果。您如果要退出研究，不需要给出相应理由，请直接通过邮箱或者微信联系我即可。

What will happen if I participate in the project?

如果我参与此项研究会发生什么？

You and your child(ren) will participate in our project as a family group, and the whole proejct will take you about 8-10 months since I want to get to know your family really well. First of all, I will gaining your consent and also your child(ren)'s assent before letting you participate in any activity. That is to say, if you want to participate in the project, please sign the consent form, then I will arrange a mutually convenient time online and explain this project orally to the child(ren). If they also want to participate, you are then being able to take part in the following activities.
您和您的孩子（们）将会以一个家庭为单位参与我们的研究，并且基于我想要在研究中深入了解您的家庭，整个研究会持续大约八到十个月的时间。首先，我会在让您参与任何研究活动之前，征得您和孩子的同意。也就是说如果您希望参与此项研究，请签署同意书，然后我会找一个双方都方便的时间安排一次线上见面，来口头争得孩子（们）的同意。如果他们也同意参加，那么您和孩子将一起参与接下来的一系列活动。
Then, I will hold a session with you online, to tell you more about one activity, parent-recorded videos, in great detail. I will teach you how to record video clips of your child(ren)'s home tablet use and how to send the clips to me. I hope you might be able to record 1-3 clips every 6 weeks.
下一步，我会和您进行一次线上见面，来跟您详细解释一项活动，“家长录影”。我会跟您阐明如何录制您的孩子（们）在家里使用平板设备的小视频片段，以及如何把它们发送给我。我希望您能够每六周左右录制 1-3 个小视频。
After this training session, we will begin the actual project! We will first hold an online family interview with each family, and during the interview, we will have a language portrait activity

(you and the child(ren) will use different colors to represent the languages you speak and paint on a body silhouette). Then we will have a short talk about your thoughts and experiences on your tablet use experiences, the child(ren) will also be encourged to join all the activites.
在这个环节结束之后，我们就可以正式开始研究啦！首先，我们要跟每个家庭单独举行一次线上家庭采访，并且在采访过程中，我们会进行一次"语言画像"的活动（您和您的孩子（们）将使用不同颜色来表现您使用的不同语言，并画在一张身体轮廓图的不同位置上）。然后我们会进行一次简短的谈话，您可以来分享自己以及孩子（们）使用平板设备的经历。所有的活动，我们鼓励孩子（们）也一起参与。
After the first interview, I will ask you to start recording short videos for your child(ren)'s tablet use at home. Besides, I will also draw an initial tablet use map of your child(ren) based on the conversation we have. Then let us set time for other interviews every 6 weeks, and we will talk about the clips you send me and develop the tablet use map together. When the whole 8-10 months period is done, we will see the progress together.
在第一次家庭采访结束后，我会请您开始录制孩子（们）在家中使用平板设备的小视频。另外，我会基于第一次的采访聊天，绘制一幅孩子（们）使用平板设备的初版示意图。然后，让我们一起为接下来的家庭采访设定时间，大约每六周一次。之后的采访中，我们可以针对您发送给我的小视频来进行探讨，并且一起为孩子（们）使用平板设备的初版示意图增加更多细节。当整个 8-10 个月的周期结束，我们可以一起看到整个过程以及改变。
However, if you feel the whole project time were too long for you to participate, we can discuss and be flexible with the time length and the frequency of activities (such as family interviews) if you want to participate.
当然，如果您想要参与这项研究，但觉得整个研究的周期对您来说时间过长，我们可以讨论并且灵活地调整您参与的时间长短和进行家庭采访等活动的周期。

Are there any possible benefits for me to taking part?

参与研究会给我带来哪些可能的益处？

I am aware that this is a study that will take a lot of your spare time, so I will offer you some little gifts, such as a gift voucher or some biscuits to thank you for participating. They are not expensive gifts but just a way for me to show my gratitude. Also, if we go through the whole project activities together, you might enjoy learning more about your child(ren)'s language development and tablet use from your recordings and our discussions during this period. Besides, I will also share with you the excerpts of my findings after analysing the data if you want.
我充分意识到参与此项研究可能会占用您的很多空余时间，所以我会提供小礼物，比如购物礼券或者饼干等来感谢您的参与。虽然不是很贵重的礼物，但是是一种表达我的感谢的方式。另外，如果我们一起参与了整项研究过程，您很可能会通过录制的小视频和我们的讨论总，来更加了解您的孩子（们）的语言发展和使用平板设备的情况。另外，如果您感兴趣，我还会在分析完数据之后与您分享研究发现的一些节选片段。

Will I be recorded, and how will the recordings will be used?

我会被录像吗？这些录像会如何使用呢？

Yes, all the family interviews will be recorded. I will use my device (recording pen or camera) to record them, audio or video recording are up to your choice. However, I will only record the videos/audios after gaining your consent and the child(ren)'s assent. The recordings will be used in my data analysis process and some of them can be used in the final report with no identifiable features. If you do not want me to use any of the recordings, please tell me directly, I will destroy them and never use them in any form of writing. I will not share the recordings and the videos you send me with any other person except my supervisor. All the recordings and videos will be safely stored on my password-protected computer and highly-secure UniDrive. I will only use anonymised or pseudonymised recordings in my report, while use cartoon image to cover any identifiable features of you or your child(ren) in the recordings. After doing the project, I plan to keep the anonymised data for publication needs or conference presentations, and I will destroy all the data three years after publication. No recordings that can reveal any of your personal information or identity will be used in any of my future plans. If you do not want me to keep the data after the project, I will destroy them and not use them for any further plans.

是的，所有的家庭采访会被录制。我将会使用我的设备（录音笔或者相机）来录制它们，您可以选择录制音频或者视频。当然，我只会在得到您和孩子（们）的同意之后进行视频/音频录制。这些录制的内容会用于我的数据分析阶段，其中有些内容可能会在抹去关键的可识别特征信息后，用于最后的研究报告中。如果您不希望我使用这些录制的内容，请直接告知我，我会立即销毁它们并且不回在任何写作中用到这些内容。所有的录制内容以及您发送给我的视频，我只会与我的研究导师分享，不会分享给第三方。所有的录制内容和影像资料都会被安全地储存在我有密码保护的电脑上和高安全性的 UniDrive 里。在研究报告中，我只会使用匿名或者使用假名字的录制内容，我会用卡通图像来遮盖您和孩子（们）任何在录制内容中的可识别信息。在完成此项研究之后，我计划保留已经匿名处理过的数据，用于发表论文或者进行研讨会展示的需求，我会在发表文章之后三年后销毁所有的数据，在我的后续计划中，同样不会使用含有任何可能揭露您个人信息或者身份的信息。如果您不希望我在研究项目完成之后继续保存相关数据，我会立即销毁它们并且不回将其用于后续计划。

Will my taking part in this project be kept confidential?

我参与这项研究可以被严格保密吗？

All the information that we collect about you during the course of the research will be kept strictly confidential and will only be accessible to me and my supervisor. The project has been ethically approved via the University of Sheffield's Ethics Review Procedure, as administered by the School of Education, and the University of Sheffield is the data controller. All your personal data and recordings are going to be kept as confidential, as it is mentioned above, your data will be safely stored and only anonymised data will be used in data analysis and findings. The whole project follows the GDPR guidelines and other regulations of the university.

在研究过程中所采集的您的所有信息都会被严格保密，并且只有我和我的研究导师有权访问。这项研究已经经过了谢菲尔德大学伦理道德审查过程的批准，由教育学院管理，谢菲尔德大学作为数据控制者。您的所有个人信息和录制内容将会被严格保密，如之前提到的，您的数据将会被安全地储存，并且只有匿名的数据会被使用在数据分析和研究发现中。整个研究过程都会遵守 GDPR 的相关条款和学校的其他规范。

What is the legal basis for processing my personal data?

处理我的个人信息的法律依据是什么?

This research project abides by UK data protection law. According to UK data protection legislation, we are required to inform you that the legal basis we are applying in order to process your personal data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further information can be found in the University's Privacy Notice https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

本研究项目遵守英国数据保护法。根据英国数据保护立法，我需要告知您，我处理您的个人数据使用的法律依据是"为进行与公共利益相关的项目所必需的处理"（第 6 条（1)(e)）。更多相关信息详见谢菲尔德大学的隐私声明页：https://www.sheffield.ac.uk/govern/data-protection/privacy/general。

What if something goes wrong and I wish to complain about the research or report a concern or incident?

如果在研究过程中出现问题，我想要进行投诉或者报告某些事件，应该怎么办?

If you wish to make a report of a concern or incident relating to potential exploitation, abuse or harm resulting from your involvement in this project, please contact the project's Designated Safeguarding Contact [Dr Sabine Little; s.little@sheffield.ac.uk]. If the concern or incident relates to the Designated Safeguarding Contact, or if you feel a report you have made to this Contact has not been handled in a satisfactory way, please contact the Head of the Department of Education [Professor Rebecca Lawthom; edu-hos@sheffield.ac.uk]. If the complaint relates to how your personal data has been handled, information about how to raise a complaint can be found in the University's Privacy Notice: https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

如果您想要报告与您参与本项目导致的潜在剥削、虐待或伤害有关的问题或事件，请联系该项目的指定保护联系人 [Sabine Little 博士；s.little@sheffield.ac.uk]。如果相关问题或事件与指定的保护联系人有关，或者如果您认为您向该联系人提交的报告没有得到令人满意的处理，请联系教育部负责人 [Rebecca Lawthom 教授；edu-hos@sheffield.ac.uk]。如果投诉涉及如何处理您的个人数据，有关如何提出投诉的详情可以在大学的隐私声明中找到：https://www.sheffield.ac.uk/govern/data-protection/privacy/general。

Contacting me for further information: 更多详情，请联系我：

PhD Candidate, Kexin Cheng, University of Sheffield.
Email: kcheng12@sheffield.ac.uk
WeChat: Jenny_ckx
博士候选人，程可欣，谢菲尔德大学
电子邮箱：kcheng12@sheffield.ac.uk
微信：Jenny_ckx

Appendix 3 Consent form

Explore Young Chinese-English Bilinguals' Home Tablet Use and Literacy Development

Consent Form

Please tick the appropriate boxes	**Yes**	**No**
Taking Part in the Project		
I have read and understood the project information sheet dated xx/xx/2022 or the project has been fully explained to me. (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.)	☐	☐
I have been given the opportunity to ask questions about the project.	☐	☐
I agree to take part in the project. I understand that taking part in the project will include being interviewed several times during the whole project, doing the language portrait activity, being video recorded, recording video clips of my child(ren), drawing tablet use mediagrams with the child(ren) and the researcher.	☐	☐
I understand that by choosing to participate as a volunteer in this research, this does not create a legally binding agreement nor is it intended to create an employment relationship with the University of Sheffield.	☐	☐
I understand that my taking part is voluntary and that I can withdraw from the study at any time during the whole process; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw.	☐	☐
How my information will be used during and after the project		
I understand my personal details such as name, phone number, address and email address etc. will not be revealed to people outside the project.	☐	☐
I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.	☐	☐
I understand and agree that authorised researchers may use my data in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐
So that the information you provide can be used legally by the researchers		
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield.	☐	☐

Name of participant [printed] Signature Date

Name of Researcher [printed] Signature Date

Project contact details for further information:

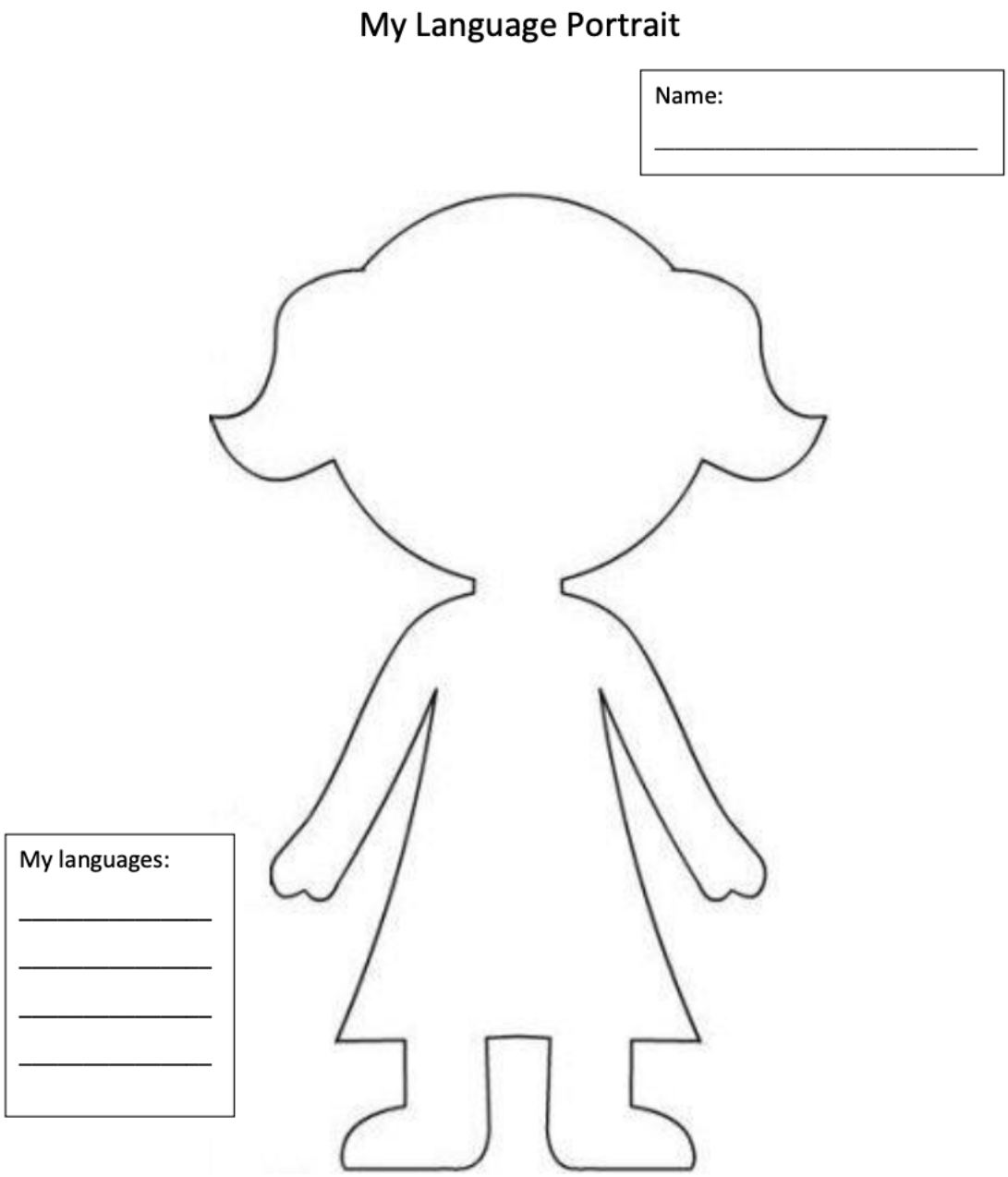
Lead researcher: PhD Candidate, Kexin Cheng, School of Education, University of Sheffield.
Email: kcheng12@sheffield.ac.uk; WeChat: Jenny_ckx; Tel: +44 (0)7421259295.

Supervisor: Dr Sabine Little, School of Education, University of Sheffield.
Email: s.little@sheffield.ac.uk; Tel: +44 114 222 8089.

Head of Department:
Professor Rebecca Lawthom, Head of School, School of Education, University of Sheffield.
Email: edu-hos@sheffield.ac.uk.

Appendix 4 Language portrait pictures

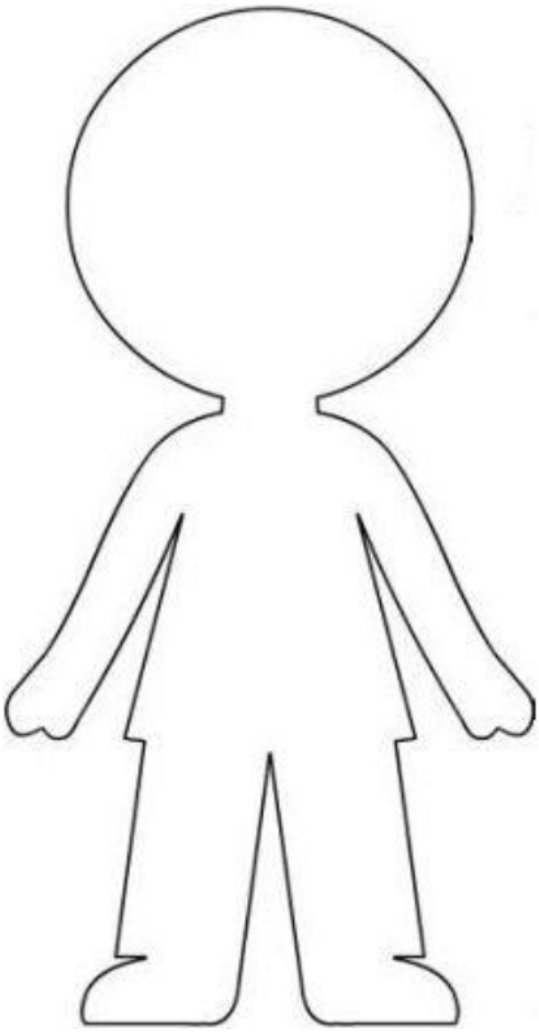
(From Lost Wor(l)ds – www.multilingualism-in-schools.net)



My Language Portrait

Name:

_____



My languages:

_____

_____

_____

_____

Can you say a bit about why you chose to draw your language portrait the way you did?

_____

Lost Wor(l)ds – www.multilingualism-in-schools.net

Appendix 5 Mind map of Bronfenbrenner's ecological model (2006)