Exploring The Development of Theory of Mind in Children with Down's syndrome

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The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

This study examines the development of theory of mind in children with Down's syndrome between the ages of 2 and 9. Children were assessed in 3 age groups: group 1 = age 2/3 (n=15), group 2 = ages 4/5 (n=9) and group 3 = ages 7/9 (n=15). A range of assessments were used to examine the precursors of and development of theory of mind skills: semi-structured play tasks with groups 1 and 2 and a range of established and novel theory of mind tasks with group 3. Groups 2 and 3 also undertook a language comprehension assessment which has also been considered in terms of its reliability for this group of children. A mixed methods approach to data collection and analysis allowed for both quantitative and qualitative data to be reported. Results show that children with Down's syndrome develop their theory of mind at a slow pace and through potentially different mechanisms than seen in the typically developing population. Development may be constrained by a range of factors; joint attention, inhibitory control, working memory, foundational knowledge schemas and representational ability. This study showed that children with Down's syndrome display features of theory of mind development in social situations in advance of passing theory of mind tasks and they were likely to use increasingly sophisticated social means to reject or modify a task. The findings from this study are considered with attention to a neuroconstructivist approach and are framed within the discourse of disability rights. Particular consideration is given to the application of the findings in relation to building an equitable education system for individuals with cognitive variance. Practical suggestions are outlined to encourage practitioners to acknowledge and support this essential area of a child's development and the application of findings are discussed in terms of other groups of children who may benefit from similar support.

Key words: Down's syndrome, theory of mind, cognitive development, disability, education

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Chapter 1: Introduction

In 2009 my daughter was born and soon after her birth she was diagnosed with Down's syndrome. Not long after her diagnosis the questions started for me. First of all it was questions specifically related to my daughter; how is her heart, when will she smile, does she show signs of x, y or z, will she learn to sit up, to walk, to talk? Partly because I am a teacher and so interested in learning and development, these soon developed into questions about all children with Down's syndrome; why is it that they find it difficult to learn to talk or to learn about numbers, what aspects of their cognition helps or hinders learning, how do their life experiences differ from those born without a disability? Whilst engaged as a practitioner working with infants with Down's syndrome on their early development skills, I was interested to note how the concrete aspects of learning in the very early years (such as learning to put an object 'in' or learning to match picture cards) was slow but consistent. However, as the children got older and learning was more abstract (learning about colour, numbers and categories for example), their learning appeared inconsistent and took much longer to consolidate.

Initial ideas for this study were based around early development and particularly focused on how I could assess the effectiveness of the type of early intervention programmes I was involved in teaching. However as the initial themes developed, a focus on the perceived difficulty with abstract concepts took precedence along with an interest in the development of theory of mind and social cognition. Figure 1 shows an early sketch of my understanding of some developmental processes, the thick black line marking the point at which I felt there may be a difference in developmental progress for the child with Down's syndrome. I hypothesized that children with Down's syndrome may slow in their development when they reach this critical point where a number of skills diverge. Over the course of this thesis I show that these initial hunches were in many ways quite accurate and that the developments observed in the cohort studied are similar to the areas I originally highlighted. From this initial hypothesis two research questions emerged:

1. How does theory of mind, or social cognition, develop in children with Down's syndrome?
2. How might this developmental trajectory impact on learning?

The first question will be answered in part by the study itself; I have been able to show when children with Down's syndrome acquire certain skills which lead to the development of theory of mind. I have been able to use prior literature to suggest how this development takes place and what constraints may be placed on the development. Answering the second question has been more conjecture and will need further studies to deepen our understanding of how theory of mind skills impact on learning. From the results of the current study I am able to suggest what impact differences in theory of mind may have on the learning abilities of individuals with Down's syndrome, but these suggestions remain to be tested.

Being a parent of a child with Down's syndrome and researching Down's syndrome has in some ways been very difficult and in many ways very enlightening. During the initial stages of research it quickly became apparent that I would need to become hardened to discussions of 'deviant' and 'delayed' development and the discourse of 'deficiency' and 'disorders'. What I felt was lost amongst all the data however, were the real people who were the subject of the papers; people who had lived experience above and beyond that which was being measured. My concern over the discourse of disability in research literature encouraged me to focus my research on becoming very person centred; at the heart of my work were to be the children I was working with and their families. I wanted the children and families to take positives away from the experience of being involved with research. The tasks were designed to be very child centred; it was essential that the children enjoyed and engaged with the tasks and felt comfortable with me as a researcher (see chapter 6). I also ensured the involvement of parents and teaching assistants in a number of ways (see chapter 6); an important aspect of this involvement is to revisit parent support groups and schools with the findings once they have been accepted.

Aside from the practical aspects of the study design I also made theoretical choices which were built on a person-centred approach. The decision to move away from a comparative study of typically developing children and children with Down's syndrome was based on the belief that individuals with Down's syndrome may have their own developmental trajectory and that this does not need to be compared to that of typically developing children. We should be able, eventually, to assess where a child is in their development against developmental milestones which are specific to individuals with Down's syndrome. For example, it would be enlightening to one day be able to say this 4 year old child with Down's syndrome 'is working at the level of a 4 year old with Down's syndrome' instead of this 4 year old child with Down's syndrome 'is working at the level of a typically developing 2 year old'. An important reason for making this distinction is that a child of 4 with Down's syndrome has had very different experiences to a typically developing child who is 2 (not least 2 extra years of experiences). So a child of 4 with Down's syndrome is not working at the same level of a child of 2 because the child with Down's syndrome brings from those 4 years a very different set of skills, knowledge and understanding of the world. Unless we make a conscious effort to move away from measuring those with disabilities against those without, we will be trapped in a cycle of describing disability as lesser and as lacking. And perhaps more importantly, we will perpetuate a notion of the superiority of typicality.

One way in which we may be able to move away from this type of measurement is by utilising a neuroconstructivist approach to development, which is underpinned by recognising that small variations in brain morphology can affect developmental trajectories. This approach recognises that difference may stem from the very beginnings of development and supports an argument of specific patterns of development (as opposed to typical development which is then modified by disability). In chapter 2 I outline how a neuroconstructivist approach has been used to underpin the research and explain how it can help us to move away from models of deviance and delay.

My final commitment to a person-centred approach is the recognition of the limitations of terminology used in research about those with disabilities. In reading research dating back to the 1960's I was unsurprised to encounter terminology which is dated and offensive. Although I recognise that there are no easy answers to the terminology debate, there are terms which advance ableism and demote diversity. Particularly problematic are the terms 'disabled' and 'difference', which for some should refer to the way society disables individuals and are not about the individual (Connors & Stalker, 2007). In 1976 The Union of the Physically Impaired Against Segregation suggested a distinction between impairment and disability:

Thus we define impairment as lacking part of or all of a limb, or having a defective limb, organ or mechanism of the body; and disability as the disadvantage or restriction of activity caused by a contemporary social organisation which takes no or little account of people who have physical impairments and thus excludes them from participation in the mainstream of social activities. Physical disability is therefore a particular form of social oppression. (UPIAS, 1976, pg. 14)

This was later changed from the limitation of 'physical' impairments to include all impairments (Oliver & Barnes, 2012) and it is this definition of disability which I will use throughout this thesis.

I will use the term 'cognitive variance' to describe the cognitive functional differences of individuals with Down's syndrome. In using this term I recognise that there are cognitive differences which create different ways of and difficulties in learning. I have chosen cognitive *variance* over cognitive *difficulty* because I believe the label *difficulty* enhances a perception that people with learning disabilities suffer from hardship. *Difficulty* suggests something that must be struggled against and that can be overcome. *Variance* refers to the way the brain is differently constructed and therefore allows acceptance of difference rather than seeing difference as something which can be changed.

The use of cognitive variance does not suggest however that we must just accept that people with Down's syndrome 'can't do' certain things. I suggest that we change our teaching styles and methods and our school and community inclusion practices in order to allow strengths to support learning and to work alongside variance. I feel that it is an essential part of our work, as teachers, researchers and academics, to investigate, to create ideas and work towards societal solutions to make sure that a variance or impairment does not become a disability. These ideas are discussed more fully in Chapter 12.

The next 5 chapters discuss the theoretical and practical underpinnings of this study. Chapter 2 describes how a neuroconstructivist approach underpins this research. In Chapter 3 I describe how theory of mind develops in typically developing children and Chapters 4 and 5 link this with what is known about children with Down's syndrome. This may seem a contradiction of the commitment to not comparing the two groups and in some ways it is. The use of a typical trajectory is to identify elements which are seen as important to a development of theory of mind and then attempt to identify if and how these elements emerge in a cohort of children with Down's syndrome. I will be using typical development as a blue print, but I am not suggesting it is the *only* print. Chapter 6 explains the design of the study and discusses in detail some of my methodological choices. Chapters 7, 8, 9 and 10 describe the results and discuss what kind of a developmental trajectory the findings suggest. The final chapters focus on an important aspect of our study; what we do with the results. Because my background is in teaching it was not enough for me to just find results. It is important that the results can help teachers, teaching assistants and communities deliver a curriculum in a way that is meaningful for children with Down's syndrome. Note here the focus on teachers; the results and discussion emphasise the internal variance, but my recommendations in chapters 12 and 13 are focussed on changing teaching styles and educational practices to support learners, not to try and ameliorate students' impairment.

Most students of a PhD begin with grandiose ideas about how their research may change the world. Unless one is lucky enough to be studying a science which interests the media, or happens upon a medical breakthrough, is it unlikely our research will be noticed very much. If we are very lucky our work may become recognised amongst similar scholars and may even have a little impact. For me, this research is personal and my focus is very much about impact. Even though my study is complete, my commitment to the individuals I worked with will ensure the findings are disseminated and discussed amongst parents, practitioners and teachers and that this work has real impact on the lives of individuals with Down's syndrome. In the end this research *is* about changing the world, just a little bit.

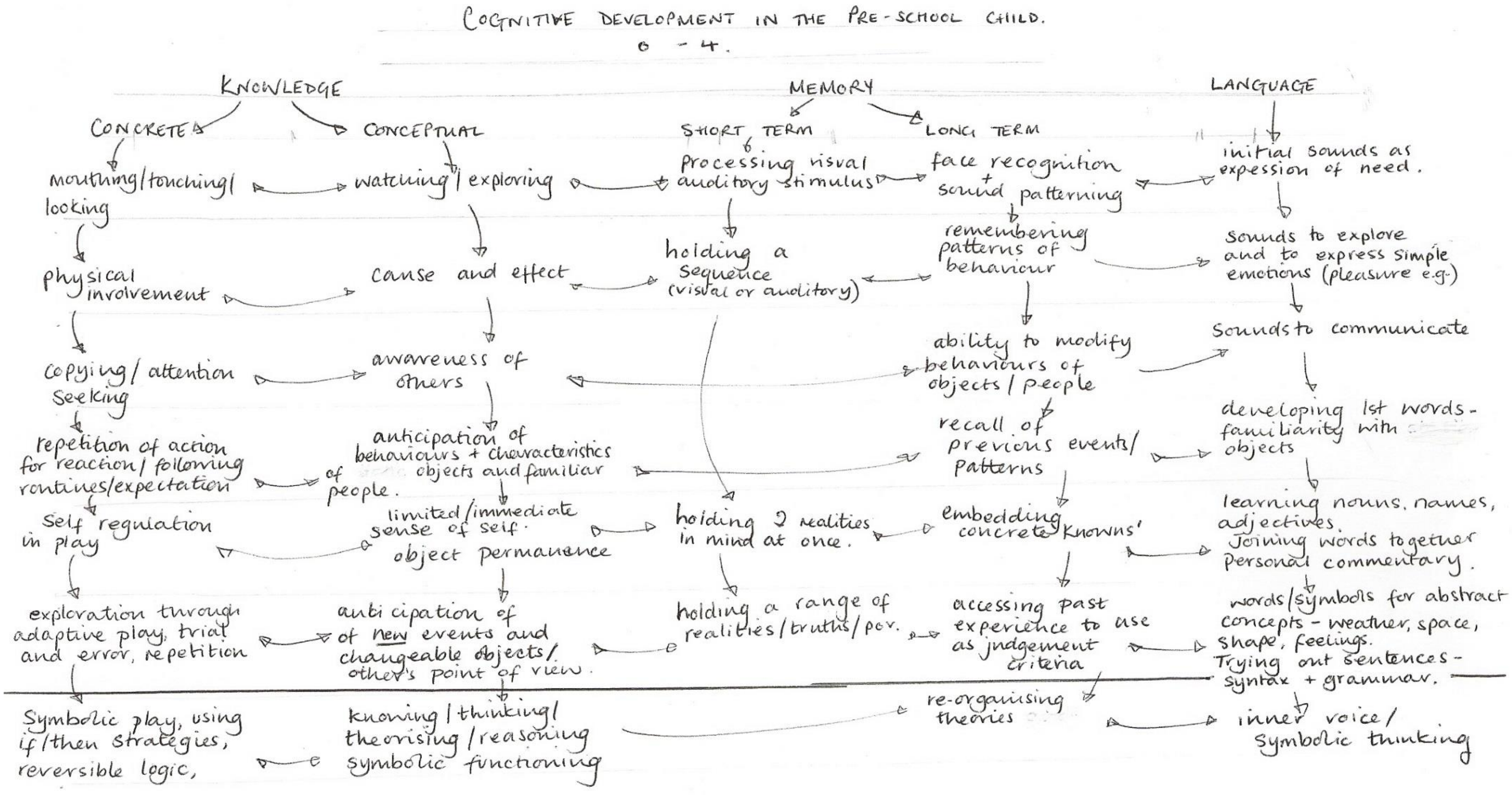

Figure 1. An early interpretation of an overview of child development

The thick black line suggests where children with Down's syndrome may have difficulties

Chapter 2: A Neuroconstructivist Approach

To examine the development of children with Down's syndrome this study is framed using a neuroconstructivist model (Karmiloff-Smith, 1995). The neuroconstructivist model considers the biological and genetic basis for development and explains how very small differences in brain morphology can create different developmental pathways for different genetic conditions (Karmiloff-Smith, 1995). It is beyond the scope of this study to detail the brain morphology and genetic basis of individuals with Down's syndrome (although this is touched on in Chapter 4), and so this area of the theoretical construct of the neuroconstructivist model will not be discussed in detail. What the model does offer however, is a move away from the 'deviance or delay' models of atypical development and instead considers what motivates a 'delayed' or 'deviant' trajectory (Thomas et al., 2009).

A difficulty with the 'delay' model, and this particularly relevant when considering individuals with Down's syndrome, is that it supposes that development will continue until the same end point is reached for everyone (Martin, 2001). Therefore if language, for instance, is merely delayed, it may take longer but eventually the individual will have a fully developed linguistic profile. With regards to Down's syndrome, very young infants are considered to be following the same cognitive developmental path as their typically developing peers, just at a much slower rate. They are able to smile, imitate and use looking and noises to communicate only weeks or months after their typically developing peers (Berger & Cunningham, 1981; Carvajal & Iglesias, 2000). However much later in their development they show a cognitive profile which is not consistent with this 'slow but same' concept (Silverman, 2007), they are liable to overuse social skills (Abbeduto et al., 2001), they have poor number skills (Paterson, 2001) and speech is often poorly articulated (Kumin, 2006). So although they may appear to begin at the same place as their peers, their end point is not at all 'normal', even if we consider this end point to be far into adulthood.

A delay model can only account for global differences, and cannot account for differences in specific functions (or domains). Consideration of the 'deviance' model offers little more to understanding development in Down's syndrome. A deviance model suggests that individuals have either 'intact' or 'faulty' domains, modules or functions. This model suggests that children are able to function at the level of general cognitive delay in most areas, but they are specifically deficient in particular areas. An example of this is Baron-Cohen's research into theory of mind in autistic children. Many of the autistic children in his studies failed the theory of mind false belief task, but showed average IQ scores. This conflict led to the conclusion that children with autism have a specific deficit in representational abilities (Baron-Cohen, Leslie, & Frith, 1985) although see Peterson, Slaughter, Peterson, and Premack (2013) for an alternative interpretation. Karmilloff-Smith however, suggests that this develops as a result of lack of infant 'preferential interest' in faces, voices and movement (Karmiloff-Smith, 1995, pg. 121). She suggests that this sets up a developmental trajectory which moves them away from a typical developmental pathway and is shown through observable behaviours in their theory of mind abilities.

The neuroconstructivist model offers an account of development which allows for a disjunction between starting place and developmental outcomes and is able to account for difference in a more intricate way than a deviance model allows. In essence it suggests that, because of tiny individual variations in brain morphology and gene expression, the starting points for individuals with cognitive variance may be very similar, but not the same as typically developing infants. As development takes place the tiny variations force learning through different routes (which may end up with the same outcomes, or not) and create pathways which are different than those in the typically developing brain. So what may look like 'typical but slow' development may actually have been achieved by a very untypical route (Karmiloff-Smith, 1998). In discussing the cognitive development of children with Down's syndrome Fidler, Most and Philofsky sum up a neuroconstructivist approach:

While the existence of a genetic insult, such as trisomy 21 or a translocation involving chromosome 21, does alter the early starting states of the developing, development still proceeds in the direction of greater complexity. But because of these variations in starting states, the self-organisation process creates patterns and order out of different raw materials or ingredients, with the presence of different constraints on functioning. Over time, areas of pronounced strength become apparent, and areas of pronounced weakness begin to emerge as well. In this way (to paraphrase Annette Karmiloff-Smith), the dynamic process of development is what constructs the phenotypic outcomes that are observed cross-sectionally in middle childhood and beyond in this population. (Fidler, Most, & Philofsky, 2009, pg. 40)

Karmiloff-Smith positions her theory between the nativist description of the infant who possesses innate domain specific modules which are essentially 'switched on' during development, (for example Fordor (1983)) and constructivism which theorises that the child's mind is a blank slate which gradually develops with input from the environment and its senses (for example Piaget (1959)). Karmiloff-Smith (1998) joins the two theories by suggesting that the child is born with *some* processes which are domain relevant (as opposed to specific). Domain relevant processes become specific with use and with sensory and environmental influences. For individuals with non-typical development this could mean that the way their domain-relevant processes become domain-specific could happen via a different developmental trajectory (Fidler et al., 2009; Karmiloff-Smith, 2013; Paterson, 2001).

An essential element of this theory is to examine development using longitudinal rather than cross sectional data. This enables observation over time and is focussed on documenting the developmental trajectory of a group or a particular process (Thomas et al., 2009). In particular this approach allows for examination of typically developing groups and developmentally different groups over time, which may show at what points the two groups diverge or converge. The focus on 'process' rather than 'module' is also a key component of a neuroconstructivist approach. Karmiloff-Smith demonstrates that difficulties in underlying processes may present as a damaged or deficient module if data is only taken from one time point examining one domain. If a longitudinal approach is taken and multiple domains are measured it may become clear that it is an underdeveloped process which is causing the difficulty, rather than a complete module (Ansari & Karmiloff-Smith, 2002). Although it has not been possible to take a longitudinal approach in the present study, some of the theory of 'process' versus 'module damage' will be used in analysis and discussion.

A further element of neuroconstructivism which Karmiloff-Smith describes is the child's understanding of representations and how they help the child organise knowledge. She posits that there are a number of levels of representation a child uses, beginning with a level of implicit representation (I) and then 3 levels of explicit representation (E1, E2, E3) which she specifies are not age related but are part of a cycle she calls 'representational redescription' (RR). At the implicit level *"representations are in the form of procedures for analysing and responding to stimuli in the external environment"* (Karmiloff-Smith, 1995, pg. 20). These are not available across domains and cannot be linked. At the explicit level representations are initially reduced descriptions of the external environment which lose detail but are available across domains (E1), then representations which are available to conscious access but not to verbal report (E2) and finally conscious representations which are accessible to verbal report (E3). The process of representational redescription facilitates the integration of these representational levels and is an ongoing cyclical process. This aspect of the neuroconstructivist theory is discussed in more detail in Chapter 3, alongside other theories of representation in relation to the child's developing theory of mind.

The neuroconstructivist approach is much more complex theory than can be described here. It links to computational modelling (Mareschal et al., 2007), deep descriptions of modelling developmental trajectories (Thomas et al., 2009), it has a complex and important relationship with brain morphology (Sirois et al., 2008) and is not a universally acclaimed concept (Ramus, 2004). The focus here is on the elements of the theory which may help to explain and frame the findings in this study. Areas which do not fit neatly, or are incompatible with the present study methodology may have been bypassed. However, as Wellman suggests in discussing using a framework theory to examine mental phenomena, *“[…] framework theories define the ontology and the basic causal devices for their specific theories and even constrain some aspects of accepted methodology […]”* (Wellman, 1990 pg. 125). Because of the focus on the typical child in many developmental theories there may not be the necessary room within these ontologies to describe non-typical development, other than by using delay and deviance terms. Using a neuroconstructivist approach to discuss the present findings will enable a wider description of the cognitive development of individuals with Down’s syndrome than delay or deviance models. It may allow for individuals with Down’s syndrome to be credited with their own distinctive developmental trajectory, away from comparisons with what is ‘normal’.

Chapter 3: Theory of Mind

3. 1 Introduction

An important aspect of children's cognitive and social development is the growth in their understanding of others. What begins as a behavioural understanding of others (that others 'do'), develops into a desire understanding (that others 'want' and will act to fulfil their desires), and eventually, between the ages of 3 and 4 years, a belief/desire understanding (that people's actions will be moderated by their beliefs and their desires) (Wellman, 1990). This development, called by many theorists a 'theory of mind' (Baron-Cohen et al., 1985; Bretherton & Beeghly, 1982; Premack & Woodruff, 1978; Wellman, 1990) is a long process and its sophistication continues into late childhood. How the development happens, which aspects of functioning are relevant to its development and at what ages children acquire certain aspects is the debate of many years' research. This chapter will outline these debates and call attention to aspects relevant for this study.

Premack and Woodruff (1978) devised a series of novel experiments to explore the extent of apes' understanding of an actor's knowledge and purpose. The chimpanzee in the study, Sarah, was able to successfully choose how an actor might solve a problem, using an increasingly complex set of problems and outcomes, suggesting she could empathise and use her own knowledge to work out a solution to a problem. For example, she was able to choose a picture of a lit taper as a solution to the problem of a man standing by an unlit fire and shivering. This implies she understood the motivation of the actor: that he wanted to be warm. However, this does not necessarily imply attribution of a mental state. Being cold is a physical and observable state, not an unobservable mental state. In their concluding remarks, which housed more speculation than conclusion, Premack and Woodruff made the suggestion that motivational understanding and (other peoples') knowledge understanding are two points along a developmental trajectory;

Of all possible guesses, we find the most compelling one to be that inferences about motivation will precede those about knowledge, both across species and across developmental stages. (Premack & Woodruff, 1978, pg. 526)

Almost 40 years on this trajectory is still apparent in and relevant to research into theory of mind:

"Theory of Mind understandings begin in infancy but also progress; earliest understandings of intentional action give way to later richer belief-desire systems of understanding." (Wellman, 2014, pg. 26)

This trajectory may prove to be important when examining how children with Down's syndrome respond to tasks which are designed to tap into their theory of mind skills. Analysis of performance may be able to suggest how far along the route from a motivational understanding of others to a mental state understanding of others children with Down's syndrome are at different ages.

3.2 What is theory of mind?

To be able to accurately predict, explain and manipulate others' behaviour requires us to have an understanding of others' mental states, or a 'theory of mind'. Our ability to comprehend fellow human beings as having separate, private minds allows us to be socially competent. With this understanding we can, for example, predict behavioural cause and effect, be empathetic and behave deceptively (Wellman, 1990). At the age of around 4 or 5 children are able to use these mentalising skills to predict others' behaviour (Peskin & Ardino, 2003), understand others' beliefs (Wimmer & Perner, 1983) and comment on their own mental life (Bartsch & Wellman, 1995). A key skill which has been used to quantify children's understanding of the mind is that of 'false belief' understanding. This skill necessitates an understanding not only that others have beliefs, but also that these beliefs may not always be aligned with the true state of the world (for a more detailed description see Figure 4, this chapter). An understanding of false belief marks a watershed in development which aligns with various other cognitive abilities. Children are able, at around 4 years, to understand the distinction between reality and appearance (Flavell, Green, Flavell, Watson, & Campione, 1986) and the notion of ambiguity (Ruffman, Olson, & Astington, 1991). They develop an ability to link their knowledge with the source of that knowledge (O'Neill & Gopnik, 1991) and we see changes in their understanding of language use, in particular propositional attitudes (phrases which suggest an agent holds a mental state towards a proposition)(de Villiers, 2005).

3.3 Theories of theory of mind

By using the term theory of mind an ontological commitment is made as to how children develop their understanding of mental states. Wellman (1990) suggests that children develop their theory of mind by testing and constraining their everyday understanding. He proposes that a theory of mind is like a theory because it contains three elements; it has coherence, an ontological distinction and a causal-explanatory framework. In order for children to understand the mind, they build a theory-like construction which relies on rules and orders to support learning. Theories are testable and children will ‘test’ their theory of mind in ordinary social situations, repositioning their theory as rules are confirmed or disproved.

There is, of course, disagreement amongst scholars regarding the way theory of mind is constructed, or indeed if it is constructed at all. There are theorists who suggest that theory of mind, or folk psychology, is an innate skill and the development of this skill is wholly accounted for by maturation. Meltzoff (1985) suggests that precursors which are evident in infants, for example, being able to coordinate emotions with others, are examples of this innate ability. Leslie (1987) suggests that this innate module develops through a computational ‘information processing model’ in which changes in understanding are brought about by the growing capacity to process information, rather than by adding theories and concepts.

Harris (1992) suggests that the innate module is developed by simulation, rather than by information. He argues that children learn to use their own experiences to simulate how others would think or feel in a similar situation. In this model children learn through experience and their ability to understand others changes through this experience, rather than through maturation or through theory building.

To frame present discussions about theory of mind I have focussed on 'theory-theory' (Gopnik & Wellman, 1992; Meltzoff, 1999; Perner, 1991; Wellman, 1990). Whilst alternatives are neither disproved nor ruled out, within this research it has been important to focus the analysis of the development of theory of mind in children with Down's syndrome on one conceptual framework. Theory-theory rests on the assumption that children are, as Piaget (1959) suggested 'little scientists' who test and construct theories about the world in order to understand it. In this conceptual framework children build on prior knowledge by testing out assumptions and reinterpreting evidence to form schemas of knowledge. For example, a child may have a 'dog schema' which includes information about their family pet: 'short, white, pointy ears, barks'. When they encounter another dog they have to update their 'dog' schema to include 'large, black, slobbery, floppy ears'. Schemas are built for all types of knowledge and actions; we may have a 'party' schema which allows us to anticipate what will happen at a party, or a 'driving' schema which allows us to drive a car. The advances that children make in the area of psychological understanding are supported in the development of physical and biological rules, laws and co-occurrences, suggesting that all three areas are theoretically linked (Flavell, 1988). Unlike Piaget's thinking however, theory-theory is not bound by stages and relies very much on a child's prior knowledge and learning to accelerate progress. Premack and Woodruff's early description illustrates the theory-like construction of theory of mind skills:

"A system of inferences of this kind is properly viewed as theory, first, because such states are not directly observable and, second, because the system can be used to make predictions, specifically about the behaviour of other organisms." (Premack & Woodruff, 1978, pg. 515)

The theory-theory concept frames the study presented here by allowing the child's prior knowledge to determine where they are in terms of developing their theory of mind. Aspects of the present analysis will focus on what elements of learning may have already taken place for the children and what impact this could have on their current state of knowledge acquisition and expression. As children with Down's syndrome often have social, environmental and formal learning opportunities which are modified by their cognitive variance (this is discussed in detail in Chapter 4) it can be argued that their opportunities to create and test their theories of biology, physics and psychology may be qualitatively different. Theory-theory allows room for different patterns of development according to different experiences, a model compatible with a neuroconstructivist approach. The two models share similar groundings in a constructivist framework, allowing for external and internal contributions to cognitive development. They both allow for alternative pathways of development; neuroconstructivism by using the explanation of domain–specific growth, theory-theory by allowing for prior experience and hypothesis testing to impact on development. At the level of representational change theory the two models still find common ground; Wellman's interpretation of theory-theory posits that children first develop a 'direct copy' representation (Wellman, 1990), in essence very similar to the initial Level I (implicit) internal representation suggested by Karmiloff-Smith (1995). The two models work together sympathetically; neuroconstructivism gives an overarching model of development within which theory-theory can explain a particular aspect of change.

The remainder of this chapter gives a general overview of how theory of mind develops in typically developing children, with a focus on the key areas which are to be examined in this study.

3.4 Pre-cursors to theory of mind

New-born and infant imitation provides one of the first forms of communication between the child and others in their world. When infants copy facial movements such as sticking a tongue out, and later on smiling, they are forming a communicative bond with another person. As babies mature their use of imitation in play and their ability to communicate develops in sophistication. Meltzoff suggests that not only does imitation provide children with an initial starting point for theory of mind but that, *"Reciprocal imitative games provide the infant with special information about how it is like another person and how another person is 'like me'."* (Meltzoff, 1999, pg. 256)

The development of non-verbal communication continues with the infant's ability to share a referent, termed joint attention. As a precursor to manual pointing (to point something out) joint attention happens when two people know they are both attending to the same thing. Before about 9 months infants are able to follow a gaze of an adult, however they are not actively seeking the adult's attention. Joint attention requires a coordinated communication in which *both* parties are aware there are messages which are being sent *and* received (Butterworth, 1995b). To show they are aware of the effect their communication will have on their partner the infant must share a referent by looking to it then looking back to their partner to check they have also seen it. This suggests a simple understanding that other people are 'different' and that as they do not automatically 'see what I see'. A note which may be particularly important in the present study is the difference between alternating attention and joint attention. Infants are able to alternate attention between an adult and a referent, but this does not necessarily mean they are sharing a mental focus on the referent. In order for joint attention to be assumed the child/object focus and adult/object focus must all be coordinated (Bretherton, 1991).

At around a year old children begin to develop a range of pro-social behaviours. Intentional communication, imitative learning and social referencing all form part of the child's developing focus on other people (Butterworth, 1995b). By intentionally communicating with and copying adults children are beginning to explore the differences between themselves and others. Social referencing can occur when children are exposed to an unusual situation (in experimental sessions, usually an unfamiliar noisy/action toy). Children look to their caregiver for social cues as to how to react (should I be scared/excited?) and will base their own reaction on what they observe. This development shows that the child knows their caregiver has knowledge which the child lacks, an indication of the child's growing understanding of the difference between himself and others (Meltzoff, 1999).

By 12 – 14 months children begin to more purposefully control their environment by using imperatives and declaratives in their actions and vocalisations. Imperatives are used to change an adult's intention or to change their course of action. For example, the child points, looks and vocalises towards their drink to make the adult get the drink for them. Declaratives are used more to draw attention to something, to share a referent. Both of these behaviours suggest that the child is developing a sense that other people have different perspectives, but imperatives show the child is attempting to *'change the adult's intentions so that they become aligned with its own'* (Moore & Dunham, 1995, pg. 111).

Evidence that children are beginning to develop an understanding of others' intentions is seen at around a year and a half. Meltzoff (1985) found that toddlers of 18 months were able to complete an incomplete act they had been shown by an adult. In his study of 40 children he showed his participants a number of novel incomplete actions, such as attempting to pull apart a toy bone, and then gave the participants the objects to use themselves. In 40 out of 50 trials the children were able to infer the researcher's intention from watching his action. Meltzoff (1995) suggests these infant theories are based on an understanding of others drawn from behaviour and action, with little evidence that there is any recognition of people's internal states. However, data collected through observation in naturalistic environments suggests utilising knowledge of others' internal states is a skill which toddlers are able to employ when the need is imperative and personal. In observations of 2 year olds in conflict with their mothers and siblings Dunn (1988) found that they showed *'[…]some practical understanding of others' feelings and intentions.'* (Dunn, 1988, pg. 66). However, she is keen to point out that knowledge does not imply reflection and that 2 and 3 year olds were more likely to have an incomplete and intuitive understanding, than an explicit theory. The work by Clements and Perner (1994) supports this distinction. In a series of experiments designed to assess whether young children could implicitly show an understanding of false belief they found that at 2 years and 11 months there was a sudden move from implicit to explicit understanding. Children were assessed using a looking paradigm which allowed them to show their understanding of false belief through their gaze behaviour. The authors suggest that implicit false belief understanding occurs much earlier than explicit understanding and much later still children are able to *explain* their false belief reasoning. Whilst the present study is not using such paradigms to assess implicit understanding, this research may be important to keep in mind when analysing the qualitative data; children's gaze behaviour may give some indication of an implicit understanding of false belief.

Between 18 months and 2 years typically developing children begin to take part in pretend play and symbolic play (Doherty, 2009). These types of play require the child to use their mental ability to imagine something is there which is not, or to imagine that they are someone they are not. Astington and Jenkins' (1995) research found links between aspects of pretend play, specifically role assignment and joint planning, and later development of false belief understanding. In their cross sectional study of thirty 3 to 5 year olds they compared performance on 4 standard false belief tasks and 10 minute sessions of pretend play. They suggest that the links between false belief and role assignment and joint planning are specific because in these aspects of pretend play it is crucial that you understand your partner doesn't know what you are thinking. Unless you are explicit that you are 'the train driver' and they are 'the passenger', your play partner may not know what play script they should follow. It is important then that children involved in pretend play are able not only to pretend themselves, but follow others' pretence. Harris and Kavanaugh's (1993) extensive studies examining pretence in young children found that two year old children were able to follow the pretend play of an adult. The studies examined children from the ages of 18 months to 36 months on a range of pretend play tasks. The younger children were asked to complete or copy pretend play actions using a range of symbolic objects (for example, using a toy tea set, or bricks symbolising bananas and cake). The older children were tested using increasingly more complex pretend play actions whereby they were required to follow the researcher's play when she introduced an incongruent action (for example, pouring tea on the head of a toy). In the final study the children were asked to talk about these play sequences. To complete these tasks the children needed to recognise that the adult partner was engaged in pretence and that the adult's pretence was different than their own; a clear understanding that other people have mental processes of their own. Dunn's (1988) observations of children's pretend play revealed their interest and excitement in understanding other people:

"What stands out from these observations is the delight with which the children explored social roles and rules […] their increasing interest in the how and why people behave as they do and in the ways of the world is evident […]" (Dunn, 1988, pg. 125)

Pretend play may be an important window for children to get a glimpse of what life is like as another, and to begin to explore the mental lives of others.

The role of symbolic play has a slightly different significance in terms of the development of a theory of mind. Symbolic play requires the suspension of reality (much like pretend play) but crucially objects are able to take on different functions, they are able to be transformed. An often used example is that of a banana; in symbolic play the child can keep in mind the knowledge of the true identity of the object (a banana) and create an alternative identity (a telephone, for example) (Leslie, 1987). Thus the child can use the banana 'as if' it were a telephone whist retaining the knowledge that after the play it will go back to being a banana once again. Harris and Kavanaugh (1993) showed that not only were 2 year olds adept at using one object as a substitute for another, they also understood the boundaries of when the object returned to it's actual identity and could assume a number of identities for the same object, depending on the play context.

3.5 Understanding the mind

Wellman (1990) suggests that at 3 years old children begin to make the important distinction between thoughts and things. In a series of studies of children aged between 3 and 5 Wellman and Estes (In Wellman, 1990) found that children of 3 are not only able to separate mental and physical entities, they are also able to express an understanding of why they are different. Between the ages of 3 and 5 the children in their studies used more frequent *mental* entity explanations for question such as, why you couldn't touch a cookie that someone was thinking of (it's not real, it's just in his head, for example). At the same time children are using their developing language abilities to discover more about the mental states of other people. Within the family environment there is a move from a concern over self, to an inquisitiveness about other people's feeling states (Dunn, 1988). In an analysis of 10 children's natural speech between the ages of 7 months and 7 years and 10 months (using samples from the CHILDES database) Bartsch and Wellman (1995) also found that children of 3 years are able to use mental state terms such as 'think', 'know' and 'believe'. Over the course of the child's first 3 years then, there appears to be an imperative for the child to learn to acknowledge, communicate with and eventually mentally synchronise with those around them. Children use their world knowledge and conceptual knowledge to develop their pretend play sequences and, by the time they are 3, are using their sophisticated language ability to find out about and describe others' thoughts and feelings. These social, conceptual and cognitive developments, which are summed up in Figure 2, are supported by the child's growing ability to use mental representations. These form the basis for humans' ability to understand abstract concepts and are what sets us apart from even our closest animal relatives.

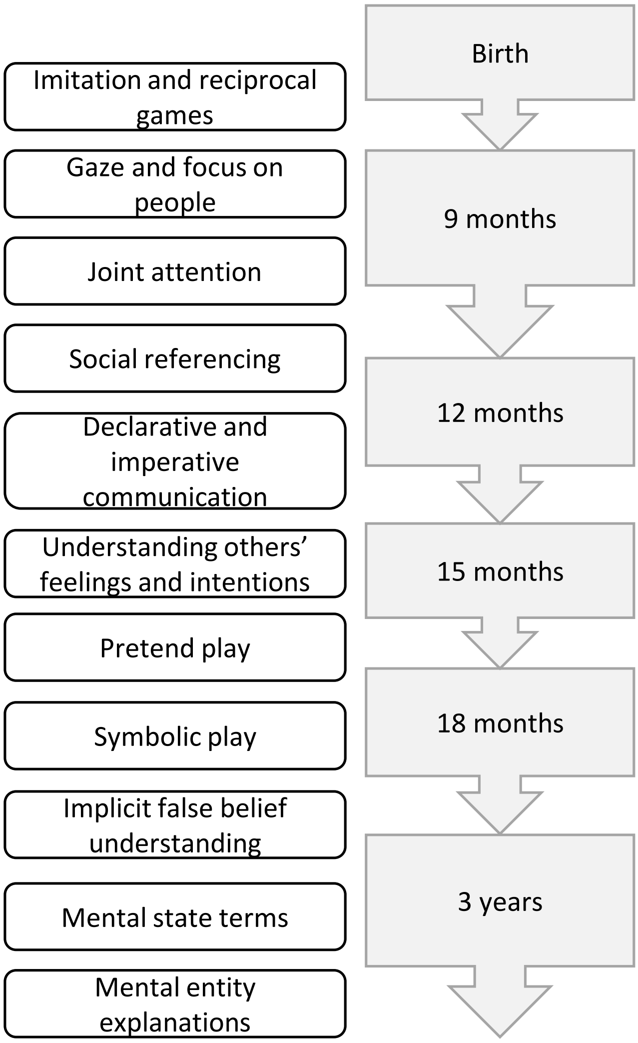

Figure 2. Summative timeline of the precursors to theory of mind

3.6 Mental representations

'Representations' are mental states about the world which we form continuously and which inform our actions and behaviours. They are not consciously formed and many representations can be held at one time. Representations are psychological and take the form of thoughts, beliefs, dreams, ideas, imaginings, pretences and semantic concepts (Perner, 1991; Wellman, 1990). If I ask you to think of an apple, you will think of an apple in your head, thus you have formed a representation of an apple. This representation may take a variety of forms, which are difficult to describe, some people may 'see' an apple in their mind, some may represent the word, and others may just have a sense of 'appleness'. Olson and Campbell (1993) offer some useful distinctions to help us describe representations. They separate out symbols from representations, suggesting that whereas a symbol *stands for* something, a representation is not *caused by* anything and is not *bound to* the thing it represents in any way. There is also the difficult question of how we learn to represent. Olson and Campbell offer some suggestion here too:

"[…] since we can think about the future as well as the past, since - as was demonstrated long ago - thought can proceed without imagery, and since there can scarcely be any convention binding mental representations to their designata, either the mind must construct its own representational apparatus or the representational powers of the mind must somehow be derived from the 'internalization' of public symbols." (Olson & Campbell, 1993 pg. 12)

For all the consensus of the fact that people have a representational ability, and the numerous models of how representational ability changes with mental and chronological age (which will be covered later in this chapter), there are few explanations as to the underlying mechanisms of what allows representation to occur and change. In fact, the authors above resolve this issue by taking a stance which could be considered as consistent with a neuroconstructivist approach. They propose that *"the appearance of thought mediated by external representations (public symbols) runs exactly parallel with the development of thought mediated by internal representations."* (Olson & Campbell, 1993, pg. 13). It seems sensible that the child will utilise its growing understanding of external symbols to support a developing internal system of thought. For example, understanding that words on a page are symbolic of an object or entity allows for the abstraction of the symbol away from the object. Thus the written word 'dog' is not a dog, does not resemble a dog, and is an entity in its own right. Similarly, the *thought of* 'dog' (not 'a' dog) is not a dog and does not stand for a dog, but it remains a mental entity in its own right. It does not need to be tethered to the object it refers to in order to exist.

It takes many years for children to develop initial mental representations, then to know they are forming them (termed meta-representation) and finally to know that others are forming them (and that others' representations are private and all different). The development of representational skill runs concurrent with the pre-cursors to theory of mind and is an essential component of how these pre-cursors are able to develop. There are a range of theories as to how representational ability develops through childhood; however there are similarities between them.

It is thought that babies are able only to represent a static and simple model of the world 'as it is'. This is alternatively termed as direct-copy understanding (Wellman, 1990), a single updating model of the world (Perner, 1991), a level I (Implicit) representation (Karmiloff-Smith, 1995) and a primary representation (Leslie, 1987). Although these models differ in the detail of the way this happens, they share an overarching consensus that, at this level children can only mentally represent what is directly observable at that time and are unable to mentally transform or reuse this information.

Babies at this level of representation show surprise that objects appear and disappear and are unable to search for an object which has been hidden and then displaced out of sight (Doherty, 2009). Piaget took this lack of 'object permanence' as a sign the infant *'lacks the symbolic function; that is, he does not have the representations by which he can evoke persons or objects in their absence'* (Piaget, Inhelder, & Weaver, 1969, pg. 3). Whilst Piaget suggested that representational ability began to appear at about 2 years, more recent research suggests it is evident a little earlier. Infants at 18 months begin to develop representational ability which can accommodate prior information as well as present states (Perner, 1991).

Perner describes this as the child developing a 'multiple model' of representation. Wellman (1990) suggests this development happens through a slow shift from his 'direct-copy' model to an 'interpretive' model, and for Karmiloff-Smith (1995) this change occurs through movement to explicit E1 representations. Leslie (1987) uses the term meta-representation for this change, as he suggests that at the point that children begin to engage in pretend play they need to produce two representations of the world. One which is the primary representation, which must be kept safe as it represents reality, and one which is a representation *of the* primary representation which can be changed to adapt to the pretend play scenario.

Whist there is debate around the exact nature of how children do this there is some consensus that it requires an ability to create a number of representations (Astington, 1993; Karmiloff-Smith, 1995; Leslie, 1987; Perner, 1991). In pretend play the initial primary or reality based representation; 'I have a stick' must be preserved as reality, but the secondary representation is able to include fabricated elements; 'This stick is a magic wand'. Initially, children make supported representations; they use a miniature tea set to support pouring pretend tea, therefore only needing to represent some imaginary tea. But as children's play develops they use layers of representations which are mutable and supported by non-analogous props; 'I pretend that this stick is a wand and that this tree is a castle and that there is an invisible dragon in the garden'.

At 2 years children are able to talk about their pretend play (Astington, 1993) and this understanding that 'I am pretending' shows the beginnings of a self-awareness and a recognition of their own mental abilities: *'The emergence of pretence is seen as the beginnings of a capacity to understand cognition itself'* (Leslie, 1987 pg. 416). The term meta-representation is used rather differently by Perner (1991), who suggests that this doesn't occur until children become 'representational theorists' (Perner, 1991, pg. 9). He considers, in the same way as Wellman suggests an interpretive model, that at around 4 years old children become aware of misrepresentation and can consider that representations are subjective. Karmiloff-Smith also suggests a change at this age, from explicit E1 to explicit E2 representations, recognising the shift in children's conceptualisation of belief.

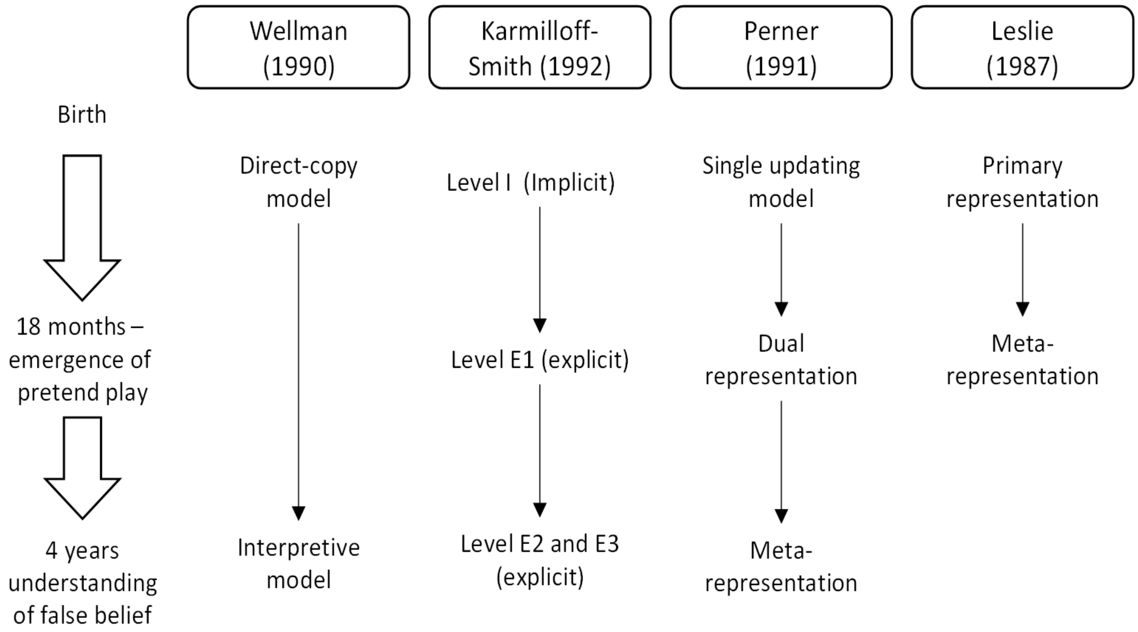

Figure 3. Four models of the development of representational ability in children

Figure 3 shows the similarities between the four theories outlined above and from it it is possible to see that three of the four theorists agree that children undergo some representational changes at around 18 months and again at about 4 years. Wellman's opinion differs somewhat in that a fundamental shift happens at 4 years, but until then a 'direct copy' representation is in place.

Children's representational ability develops alongside other cognitive processes and their acquisition of knowledge about the world. Without knowledge about the world children would not be able to understand object permanence (they need knowledge of simple physical states), and they would not be able to engage in pretend play (they need knowledge, for example, of liquid states in order to pretend pouring tea, or of how a telephone works in order to transform a banana into a telephone). Representational ability does not occur in isolation and it is these underlying knowledge schema which may allow for the development of representations (Olson & Campbell, 1993).

3.7 False belief and metarepresentation

The culmination of the theory building that children have been doing in their first 4 years is evident in their understanding of false belief. Children move, with evident consistency, from not passing a range of false belief tasks at age 3, to passing them at age 4 (Wellman, Cross, & Watson, 2001). An understanding of false belief relies on the recognition that a person's belief may not always align with reality. For example, I may *believe* there is milk in the fridge, but when I look, it has all gone. This mismatch between what I believe and what is actually real is seemingly an impossible incongruity for 3 year olds to comprehend. Even when tasks are modified, language simplified or paradigms changed, although there are slight downward shifts in passing age, still most 3 year olds are unable to pass tasks designed to address false belief understanding (Wellman et al., 2001). Figure 4 describes a number of classic paradigms which have been used to test for children's understanding of the incongruity between belief and reality. The areas described appear to develop concurrently and are evident in most typically developing children at 4 years (Flavell, Miller, & Miller, 1993).

False belief task: displacement (Wimmer & Perner, 1983).

The experimenter shows the child a story: Maxi has some chocolate. He and his mother put it in a drawer. Maxi goes out to play. His mother moves the chocolate to a cupboard. Maxi comes back in, he wants his chocolate.
The experimenter asks three questions:
Where will Maxi look for his chocolate?
Where did Maxi put his chocolate?
Where did his mother put the chocolate?

In order to show their understanding of Maxi's false belief the child must answer all three questions correctly. Children under 4 often point Maxi to the place where his mother has moved the chocolate to.

The child needs to be able to represent the contents of Maxi's mind (his false belief) which requires meta-representation.

Visual Perspective taking (Donaldson & Hughes, 1979)

The child is shown dolls of a policeman and a boy and a scaled down 'wall'. They are told the policeman wants to find the boy, and the boy wants to hide from the policeman. The dolls are placed at various points on a table (for example directly opposite each other, or diagonally opposite each other). The child is asked to place the wall so that the policeman cannot see the boy.

In order to show their understanding of other's perspectives the child must be able to imagine the policeman's point of view, to then place the wall correctly.

The child is using meta-representation to represent the policeman's representation of the situation.

Appearance reality distinctions (Flavell et al 1983)

The child is presented with a item which is made to resemble something different. For example, a sponge painted to look like granite. The child is asked 'What does this look like, with your eyes, right now?'. The true identity of the object is then revealed and the child is asked 'What is this really really, is it really really a rock, or really really a sponge?'.

Children under 4 years tend to stick with their initial response of what the object looks like. Children over 4 are able to reconfigure their knowledge based on their new information, and answer correctly.

Children who can pass this task are using meta-representation to assess their original representation and re-write it according to their new knowledge.

Ambiguity (Ruffman, Olson, Astington, 1991)

The child is shown two toy animals which are different but the same colour. For example, a grey elephant and a grey mouse. They are placed in boxes which have small windows through which a piece of the grey fur is visible. The child is asked whether someone else, who hasn't seen the animals being put in the boxes, can tell which animal they are viewing.

In order to pass this task the children must recognise that the viewer needs more information for the choice to become unambiguous.

Children able to understand the ambiguity of the information received are able to use meta-representation to represent another person's representation of the information presented.

Figure 4. Description of tasks children aged 4 are able to pass using meta-representational ability

In order for children to pass these tasks, they must have some form of meta-representational ability (Astington, 1993). As we saw above, there is discussion over when meta-representation develops and the terminology used to describe this skill (Karmiloff-Smith, 1995; Leslie, 1987; Perner, 1991; Wellman, 1990). Throughout this study the term meta-representation will be used to describe the ability to represent the content of another's mind, or to represent one's own representations, as it shows a clear progression *in terminology* from the initial use of the term 'representation'. Meta-representation is a similar construct to Karmiloff-Smith's E2 and E3 levels of representation, in that they are representations which are available to consciousness and are accessible across domains (Karmiloff-Smith, 1995).

The ability to meta-represent one's own or another's mental state brings with it an extraordinary range of developments. Children's ability to empathise, to control their own learning, to take part in cooperative (or conversely competitive) games (Flavell et al., 1993), to lie and cheat (Peskin & Ardino, 2003), to tease (Dunn, 1988), to problem solve and to work collaboratively, all require an understanding of other peoples' mental states; a theory of mind.

3.8 Working memory, language, social understanding and theory of mind

Implied at the beginning of this chapter are areas which 'underpin' the development of the child's theory of mind; working memory, language and social development. Particularly implicated in the child's ability to form a theory of mind are the three areas above which allow or constrain development through the complex interplays between environmental input and cognitive changes (Karmiloff-Smith, 1995; Wellman, 1990).

3.8.1 Working memory

The working memory system refers to the cognitive system which absorbs information, holds it for a very short while and then either transfers the information to longer term memory or 'forgets' it. For the purposes of this research the revised working memory model from Baddeley

(2000) has been used, since this model has been extensively used across research in working memory, in theory of mind and particularly in research into individuals with Down's syndrome. Baddeley and Hitch's model (Baddeley & Hitch, 1974) proposes a multi component model of working memory which comprises of a phonological loop system for the short term storage of verbal input and a visuospatial sketchpad for immediate handling of visual and spatial cues, both of which feed information to the central executive which is a 'limited capacity attentional control system' (Jarrold & Baddeley, 1997, pg. 926) but which has no space for storage. Baddeley's revision (Baddeley, 2000) added an episodic buffer to the model; this component stores and converts information from the phonological loop and the visuospatial sketchpad into 'episodes'. This then feeds into both the central executive and the long term memory systems.

The importance of the working memory system to the development of theory of mind is two-fold. From the time the child is beginning to mentally represent the present they are using their working memory to momentarily hold in mind the representation. In order to pass the false-belief task (Wimmer & Perner, 1983) outlined in Figure 4 above, the child must hold in mind two representations, the reality of the situation and the character's false belief. This requires an efficient working memory in which material doesn't deteriorate too rapidly.

The second way the working memory system is implicated in theory of mind development is through the functions of the central executive. Executive functions are the complex set of processes which enable us to, for example, plan, control inhibition and task and rule switch. This purposefully vague description highlights the difficulty scholars have in trying to describe this *'ragbag into which could be stuffed all the complex strategy selection, planning, and retrieval checking that clearly goes on when subjects perform even the apparently simple digit span task.'* (Baddeley, 1996, pg. 6)

It is suggested that inhibitory control in particular plays an important part in children's ability to respond to the false belief tasks because the child has to inhibit their natural tendency to point to the actual whereabouts of the toy/chocolate. Carlson and Moses (2001) found that children with better inhibitory control responses performed better on a range of theory of mind tasks. When examining the relationship between inhibitory control and performance of false belief tasks in particular, Carlson, Moses, and Breton (2002) found that *delayed* inhibitory control (where the subject has to delay answering) had no correlation with performance on false belief tasks and neither did performance on working memory tasks alone. However, the combined effect of working memory performance and *conflict* inhibitory control performance (where the subject has to hold in mind two responses, the correct and incorrect and then select the response which conflicts with their prepotent response) were highly correlated with performance on false belief tasks. The authors suggest that a *'combination of working memory and inhibition may be critical for mental state attribution'* (Carlson et al., 2002, pg. 82).

Precisely how these areas combine is under debate. Using data from a range of other studies Perner and Lang (1999) explored the particular links between executive functions and theory of mind development and conclude that, *'The available evidence shows that the observed correlations go beyond common methodological features of the assessment tasks, and points to a functional interdependence of ToM [theory of mind] and EF [executive function]'* (Perner & Lang, 1999, pg. 343).

3.8.2 Language development

Language developments spanning from the pre-verbal stage to an ability to describe someone else's false belief form a crucial part of the child's developing theory of mind (Astington & Baird, 2005). In the first instance, language is one type of initiation into the symbolic form; spoken words are not 'things', they stand for things. By learning to use language the child is learning to use a type of symbolic representation, it is an insight into the non-physical properties of symbols (Nelson, 2005). This ability to separate the 'real' from the linguistically symbolic may pave the way for children's later separation of physical entities and mental entities. Children begin to label their own desires early on, however, Wellman and Estes (1987) found that although children talk about wants and desires around the age of 2, they don't use terms which express a mental states, such as 'think', 'know' and 'believe', in their proper context until around their 3rd birthday. Dunn's (1988) findings agree; from her observations of children between 14 and 36 months she suggests that throughout their 3rd year children are increasingly interested in how others are feeling and others' mental states.

Studies into parent-child interactions show that exposure to mental state language in young children can influence theory of mind development in later years (Adrian, Clemente, Villanueva, & Rieffe, 2005; Ontai. L, 2008; Ruffman, Slade, & Crowe, 2002; Ruffman, Slade, Devitt, & Crowe, 2006; Tingley, Gleason, & Hooshyar, 1994). In support of this idea research suggests that preschool deaf children in hearing families may miss out on important conversations relating to others' thoughts, feelings and desires which has a later impact on their development of theory of mind (Peterson & Siegal, 1999; Peterson & Siegal, 2006; Woolfe, Want, & Siegal, 2002). As the majority of hearing families are not fluent signers, conversations about internal states are not translated for the hearing impaired child and so their exposure to such language is limited.

The language to express non-physical entities gives children a symbolic entry into their own and others' minds and a mechanism to begin to explore real world outcomes of mental states.

3.8.1 Social understanding

Since the development of a theory of mind has at its core a social purpose, (to understand self and others) it may be presumed that the child's social development runs in conjunction with theory of mind (Caputi, Lecce, Pagnin, & Banerjee, 2012). Indeed we can see how the social child develops throughout the 'precursors to theory of mind' in section 3.4 above; imitation, joint attention and pretend play are all social acts. Social development has been explored in depth in literature regarding how theory of mind is expressed in individuals with Autistic Spectrum Conditions. An important piece of work was undertaken by Baron-Cohen et al. (1985) in which they examined how individuals with Autistic Spectrum Conditions responded to false belief tasks. As most of the children with an Autistic Spectrum Condition were unable to pass the task (but did answer the reality and memory questions correctly) they concluded that this group were unable to impute others' mental states.

This study sparked huge interest in this research field and a number of studies have replicated this finding (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Happé, 1994). Others have suggested that theory of mind is not entirely absent in many individuals with Autistic Spectrum Conditions (Peterson & Siegal, 1999; Peterson et al., 2013) and some studies suggest that the difficulty in theory of mind is not restricted to those with Autistic Spectrum Conditions (Pilowsky, Yirmiya, Arbelle, & Mozes, 2000). Much of the discussion surrounding this debate relates to the interaction between theory of mind and the triad of social skill difficulties which those with Autistic Spectrum Conditions can show; social and emotional difficulties, language and communication impairments and difficulties with flexibility of thought. Some studies tentatively suggest that difficulties with social interaction and communication may lead to poor theory of mind construction (Peterson & Siegal, 1999), which raises interesting questions as to whether this may also be happening in other groups of children, such as those presented in this study.

Children's development of understanding about themselves and others' as social beings begins with an understanding of their own emotional selves and then of others. Children understand that they are, as others are, *emotional* beings much earlier than they can ascribe beliefs or thoughts to themselves or others (Dunn, 1988). Their emotional understanding of others develops into a desire-behaviour theory (she is sad because she wanted a biscuit but there weren't any) and eventually into a belief theory (she believed there were biscuits but there weren't, so now she is sad). Children's understanding may be developed, in part, through asking questions about the world around them, specifically about others' inner states (Dunn, 1988). However, there is a danger here in talking about 'the mind' and 'mental entities' that mental states become disembodied from the person when, of course, they are the person;

"The child - and we ourselves - are less aware of the mind than of the self; it isn't my mind, it's me. Similarly, an awareness of others' minds is more an awareness of other selves; it's not his mind, it's him" (Astington, 1993, pg. 160).

When children talk about the mind, they say 'I think', not 'my mind thinks' and so their relationship with the mind is wholly personal, it is about their being. When they begin to ask about others' mental states they do not ask 'Why did her mind think that?' they attribute the mind to the person; 'Why did she think that?'.

By the time the child is 4 years old, and they are able to pass the false belief tasks, a range of new social skills have also begun to emerge. Wellman (2014) suggests that *'As children acquire an explicit preschool belief desire psychology, their social actions and interactions are changed'* (pg 58). In hide and seek games the child no longer hides in full view and says 'Come and find me' but is beginning to understand the rules and concepts that underlie such games (Peskin & Ardino, 2003). At the same time their ability to deceive another person has developed and their lies are more effective in controlling another person's behaviour (Talwar & Lee, 2008). Pro-social behaviours also develop and children of 4 and 5 begin to show a greater understanding in social games (Astington & Jenkins, 1995).

This link between theory of mind skills and social competence may well continue into later childhood, impacting on peer relationships throughout school (Caputi et al., 2012). What is not established is the causal link between social understanding and theory of mind, or indeed whether the links are concerned with 'social understanding' as a whole or with specific areas (Hughes & Leekam, 2004). Does a more socially aware baby develop theory of mind skills earlier, or does the early development of theory of mind allow for a more socially competent 4 year old? The acquisition of theory of mind is a crucial part of a child's development; children who struggle to develop an initial understanding of others' beliefs and desires could find the socially complex worlds of the community, the playground and the classroom inaccessible and incomprehensible (Repacholi, 2003).

"If you did not understand that minds hold beliefs, then you would probably be inclined to treat people as machines rather than as organisms that are striving to make sense of the world. You would not be oriented towards trying to help them to understand what is out there in the world or the meaning that lies behind the literal words of another person's utterance. Evidently, the individual would experience serious difficulty in relating to others and communicating with them […]." (Mitchell, 1997, pg. 72)

This chapter has described the complex and multi-faceted development of a child's theory of mind. Exactly how representational skill happens is still very much under debate and a number of theorists propose different ways in which our mind may achieve this ability (Fordor, 1983; Karmiloff-Smith, 1995; Leslie, 1987; Perner, 1991; Wellman, 1990). How language and theory of mind relate and which is the primary driver in understanding false belief is unclear, if indeed there is a primary driver (Astington & Baird, 2005). Emergence versus expression accounts of the complex relationship between executive functions and theory of mind highlight the 'chicken and egg' nature of these cognitive developments (Moses, Carlson, & Sabbagh, 2005; Wellman, 2014) and how the complex interplay of social and cognitive developments work together to form a theory of mind is only just beginning to be fully explored. Not least amongst all these discussions should be the relevance of the combined effects of all these areas of development. Although some inroads are being made in this area by examining atypical development (Brown et al., 2003; Jarrold, Baddeley, & Hewes, 1999; Karmiloff-Smith, Klima, Bellugi, Grant, & Baron-Cohen, 1995), it would take a study of some magnitude to attempt to pull together all the pieces of this complex and intricate subject. The present study will use what is known about typically developing children's development of theory of mind to inform and extend our understanding of how this skill develops in children with Down's syndrome.

Chapter 4: Behavioural and Cognitive Phenotypes of Down's syndrome

Down's syndrome is a congenital disorder which arises from an extra arm on the 21st chromosome. Its prevalence in the UK is about 1:1000 live births, although the high termination rate (81%) (Irving, Basu, Richmond, Burn, & Wren, 2008), in antenatally diagnosed cases makes the occurrence of Down's syndrome in pregnancy much higher. Down's syndrome causes a number of physical changes, described in Table 1, some of the more complex of these can cause infant mortality.

Not all individuals will have these features, some may have many, some may have few.
Heart defects
Hypertonia (Muscle weakness)
Sandal gap (large gap between big toe and second toe)
Palmar crease (striking crease across palm of hand)
'Almond' eye shape with an epicanthic fold of upper eyelid
Foreshortening of limbs
Loose ligaments
Poor gastro – intestinal mobility
Weakened immune system
Short and bent little finger
Flattening of nose bridge
Small hands and feet
Increased likelihood of coeliac disease, hypothyroidism and childhood leukaemia

Table 1. Differences in physiology as a result of Down's syndrome.

As well as physical differences all individuals with Down's syndrome have some limited range of cognitive function. The often quoted figures in current literature are that in adulthood most individuals with Down's syndrome will have an IQ of between 25-55, rendering them 'moderately to severely retarded' (original terms retained) (Pennington, Moon, Edgin, Stedron, & Nadel, 2003, pg. 52). This data appears to have come originally from (Gibson, 1978), which makes it rather out of date. It is perhaps not a reliable reflection of current adults with Down's syndrome who may have had very different life experiences and educational opportunities and possibly a much more independent adult life than those living in the 1970's. More recently collected data suggests a slightly higher IQ between 30 – 70 (Chapman & Hesketh, 2000), who importantly highlight '[…] broad individual differences in rate of development' (pg. 87).

Over the last 15 years much of the focus in understanding the development of individuals with Down's syndrome has been on the identification of behavioural and cognitive phenotypes. The description of a phenotype aims to identify probabilistic characteristics in behaviour and development. The idea that this is a *probabilistic* outcome is an important factor when considering the developmental trajectory of individuals with Down's syndrome. The variability in profiles for this group is wide and differences in motor (Vicari, 2006), speech (Fowler, 1990) and cognitive (Tsao & Kindelberger, 2009) development are observable at all ages.

In much of the literature regarding phenotypes the terms behavioural and cognitive are interchanged (Chapman & Hesketh, 2000; Fidler et al., 2009; Fidler, 2005) and as such require definitions of use in this study. Cognitive phenotype will be used to describe the internal workings of the mind, much of which, without manipulation, is not easily outwardly unobservable: '[…] cognition includes those mental processes, both conscious and unconscious, that control virtually everything we do or think […]' (Silverman, 2007, pg. 228). To observe a cognitive phenotype, outward behaviours must be manipulated in order to assume the presence or absence of a mental process.

For the purposes of this study the definition of a behavioural phenotype assumes that behaviour is generally outwardly observable and is *as a consequence* of cognitive functions. A cognitive phenotype is then responsible, in part, for the behavioural phenotypical features which are observable from infancy in children with Down's syndrome.

4.1 Cognitive phenotype

The cognitive phenotype in individuals with Down's syndrome describes weaknesses in specific areas of functioning; working memory, executive functions (in particular attention and inhibitory responses, planning and problem solving) and processing speed (these are all covered further in chapter 5). These areas appear to be affected more than would be expected given individuals' level of IQ, or mental age. Recent interest has been on understanding how physical differences in the morphology of the brain in individuals with Down's syndrome creates a particular 'path' or pattern of learning which leads to the development of the cognitive phenotype (Fidler et al., 2009). How much the complex interaction between differences in initial brain morphology, brain plasticity and environmental factors relate to the developing cognitive phenotype is still at the early stages of debate.

Although there are clear differences between the structures of the brain in individuals with Down's syndrome and typically developing individuals, how these differences relate to development is the matter of continuing research (Dierssen, 2012; Rondal, Perera, & Spiker, 2011). It is possible that differences in the way the brain develops after the first few months sets up a complicated pattern of development influenced both by environmental and inherent cognitive factors (Fidler & Nadel, 2007). What is difficult to establish is how different domains of functioning impact upon one another to cause or affect areas of development; what may be an area of 'weakness' at one stage of development, may not show as such at a different age. It is important to recognise that a phenotype is not set at birth:

"Rather than considering outcomes as preserved or damaged modules that are wholly intact or impaired uniformly throughout development, Karmiloff-Smith (1998) argues that "tiny variations in the initial state" can become magnified throughout development into domains of relative strength and weakness. Early development may be a crucial window of opportunity for intervention, as these "tiny variations" have not yet snowballed into impairments in whole domains of processing." (Fidler, 2005, pg. 87)

These initial states may influence cognitive development, mediated by social and environmental factors, to create a particular cognitive phenotype which is apparent in individuals with Down's syndrome.

4.2 Behavioural phenotype

The behavioural phenotype often used to describe individuals with Down's syndrome has a number of key features. A common difficulty for all individuals with Down's syndrome is speech and language. Although in young children with Down's syndrome receptive vocabulary can be almost on a par with peers, expressive vocabulary is often very much reduced (Næss, Lyster, Hulme, & Melby-Lervåg, 2011). A combination of difficulties with working memory, articulation and phonology can prevent clear and syntactically correct speech (Paterson, 2001). Issues with understanding conversational pragmatics and dealing with complex social situations can compound speech difficulties and prevent people with Down's syndrome from being able to fully articulate their ideas (Abbeduto, Warren, & Conners, 2007).

Young children with Down's syndrome have also been found to have motivational deficits which may lead to unstable skill acquisition and an avoidant learning style (Wishart & Duffy, 1990). These strategies were observed in a variety of tasks which showed children were consistently unwilling to put effort into problem solving tasks, showed reversals in task competence and a refusal to complete tasks (Wishart, 2001). Gilmore and Cuskelly (2009) examined how enduring motivational aspects were in children with Down's syndrome and found that those children who showed good motivation at age 5 continued to do so into older childhood. Similarly a lack of motivation also prevailed in some children in to older childhood and the authors suggest that, for children with Down's syndrome, motivational style may well be set at a young age, in contrast to the typically developing population.

Social understanding and awareness is considered a strength for individuals with Down's syndrome. Some studies have suggested that, when compared to individuals with other intellectual disabilities, children with Down's syndrome are more sociable and likable (Cuckle &

Wilson, 2002). However other research has found that children with Down's syndrome may have some limits as to which areas of social functioning are working well and how they may use social strategies to avoid tasks. Fidler, Most, Booth-LaForce, and Kelly (2008) found that children with Down's syndrome at 12 months developed social relatedness skills, but had less well developed emotion regulation, suggesting that the children's development in these areas may be inconsistent. Similarly Wishart's findings (Wishart, 1996; Wishart, 1993) suggest that children with Down's syndrome may use their social strengths to avoid difficult learning situations. This is particularly important to consider when educationalists encourage children's behavioural and cognitive phenotypical strengths to support other areas of learning (Jones, Neil, & Feeley, 2013).

4.3 Other factors influencing the development of children with Down's syndrome

As well as cognitive and behavioural profiles, individuals with Down's syndrome can also have a number of other challenges to their developmental progress. Some of these which are relevant to developmental issues are set out briefly here. They are in brief as they are not the main focus of our study, but are of importance when considering how children with Down's syndrome learn:

Eyesight – individuals with Down's syndrome are much more likely than the typically developing population to have significant eyesight difficulties. These range from squints, difficulties with controlling eye movements, refractive errors and accommodation difficulties.

Hearing – a common cause of hearing difficulties in individuals with Down's syndrome, and particularly children, is glue ear. Glue can be treated with grommets or hearing aids and may resolve as children grow older. Some individuals with Down's syndrome have sensori-neural hearing loss which is a lifelong hearing condition.

Physical weakness – muscle weakness can affect individuals with Down's syndrome to different degrees. This can make early development such as rolling over, sitting and walking slower for some infants with Down's syndrome. Physical weakness can also make feeding and swallowing more difficult. Older children may tire easily and have less stamina than typically developing peers.

Heart problems – congenital heart problems are common in children with Down's syndrome but are often corrected early in childhood through surgery. Heart problems can mean long stays in hospital over the first few years of a child's life.

Health problems – children with Down's syndrome are much more prone to developing chest infections, have problems with their bowels and intestinal tracts and have more common colds. They are more likely to have prolonged bouts of illness and are slower to recover.

Sleep apnoea – This condition prevents individuals with Down's syndrome from sleeping properly and can cause concentration and focus difficulties if undiagnosed and untreated. [1]

4.4 Teaching and testing children with Down's syndrome

As a result of the behavioural and cognitive phenotypes and additional medical needs, individuals with Down syndrome are often attributed with a specific learning style and a range of measures are put in place in schools to aid learning. This study has used the 'learning style' of children with Down's syndrome to motivate the modifications to individual tasks and to influence the study design as a whole.

A visual learning style: Children with Down's syndrome have phonological loop difficulties causing an inefficient verbal working memory, but a relatively efficient visual working memory (Jarrold, Nadel, & Vicari, 2008). Teachers are advised to use the stronger visual working memory to support learning and individuals with Down's syndrome are attributed with a 'visual learning style'. Modifications to teaching may come in the form of visual timetables, sign supported

[1] Information taken from the Down syndrome Medical Interest group medical library: http://www.dsmig.org.uk/library/index.html. Accessed 12.38pm, 28/06/2015

speech, a physical ‘hands on’ approach to abstract tasks and using the written word to support idea construction (DSA, 2011a, 2011b).

Pace and timing: Partly because of limitations with verbal short memory, and partly because of a general learning impairment children with Down’s syndrome can find the pace of everyday interactions fast and difficult to keep up with. Conversely, some children with Down’s syndrome are bored easily by repetitive tasks and this may result in inconsistent results on tasks or refusal to comply (Wishart & Duffy, 1990).

Fine and gross motor difficulties: Many children with Down’s syndrome find that poor control and strength of their motor skills limits their ability to succeed in classroom activities. Holding a pencil with enough strength and precision to write clearly and activities which require an element of physical detail (for example craft type activities) can be a challenge. Gross motor difficulties can make children with Down’s syndrome appear clumsy and poor upper body strength can make sitting in chairs uncomfortable (DSA, 2011a, 2011b).

Other modifications which are advised for children with Down’s syndrome are clear and distinct images and text due to sight difficulties, short and precise information chunking to help with weak working memory and repeated activities to help with consolidation of new learning (Miller, Morling, & Wong, 2004).

Having detailed how individuals with Down’s syndrome are affected by their extra chromosome, Chapter 5 examines how these behavioural and cognitive phenotypes may affect the way children with Down’s syndrome may develop a theory of mind.

Chapter 5: Theory of mind development and Down's syndrome

Chapter 3 considered the developmental trajectory of theory of mind in the typically developing population, with reference to the vast literature on this topic. The literature on theory of mind in children with Down's syndrome is much more scant and the net needs to be cast much further afield to find clues as to the developmental trajectory of theory of mind in this population. As such this chapter draws from important research in the areas of Autistic Spectrum Conditions, the cognitive development of deaf children and children with non-specific learning difficulties. Very often children with Down's syndrome are used as control groups for studies of children in these other groups, so the reporting of their performance in tests is sometimes limited. Nonetheless there have been a few important studies which will be discussed in terms of methodology and outcomes.

5.1 Precursors

In their very first years, children with Down's syndrome can hit some of the same developmental milestones as their typically developing peers, albeit it at a much slower rate. They can acquire looking, feeding and smiling skills in much the same way as typically developing children and follow a similar path of initial physical development (Buckley & Sacks, 2001). However, some specific differences may be apparent early on. From 3 months babies with Down's syndrome are able to discriminate between looking at objects and looking at their mother's face (Carvajal & Iglesias, 2000). However Berger and Cunningham (1981) found that children with Down's syndrome continued to look more at their mothers at age 6 months whereas their typically developing counterparts began to look more at the world around them. At 10 months old, the authors suggest, the children with Down's syndrome were between 8 and 10 weeks behind their typically developing peers in their pattern of eye contact and that the overall pattern of eye contact in the first 6 months was qualitatively different between the two groups. The authors conclude that these early differences in eye contact may have implications for social as well as cognitive development.

In studies of non-verbal requesting behaviours, children with Down's syndrome have been found to produce fewer instrumental requests (the child's use of gestures and eye contact to elicit assistance from an adult in achieving a goal) than their typically developing peers (Mundy, Sigman, Kasari, & Yirmiya, 1988). Fidler, Philofsky, Hepburn, and Rogers (2005) also found they showed weaker problem solving behaviours linked to inefficient requesting behaviours. The children with Down's syndrome in their study showed less frequent requesting gestures (requests to get someone to do something or change someone's behaviour to be aligned with one's own) than typically developing children, but there was no difference between groups in the level of joint attention gestures (gestures designed to draw another's attention to an object). The authors suggest that the toddlers with Down's syndrome were able to use gestures to draw attention to something, but were unable to use them to moderate another's behaviour to get something.

Alongside the split between requesting gestures and joint attention gestures, Fidler et al. (2005) also found that that children with Down's syndrome needed more help with problem solving tasks and had poorer quality reach strategies. They concluded that children with Down's syndrome may have a particular deficit in the way they approach problem solving and this could be linked to poor instrumental requesting. However, they caution that this interaction could work in either direction. In the same study it was found there was no difference in the way children with Down's syndrome and typically developing children used gesture to coordinate their focus with an adult (joint attention). This is an important indicator that, initially at least, toddlers with Down's syndrome may have some of the emerging skills necessary for developing theory of mind skills. However, this must be caveated with the ages of the children in the study. The children with Down's syndrome were on average 2 years and 10 months and in contrast the typically developing children were on average 18 months. So although there was joint attention ability in the Down's syndrome group, it appeared much later than we would see in typically developing children.

Legerstee and Fisher (2008) also found that children with Down's syndrome produced co-ordinated attention at a similar *mental* age to typically developing children, but this was in limited a 'higher mental age' group in their sample (as measured using the Bayley Scales of Infant Development (Bayley, 1969)). This group had a mental age of 16.6 months (chronological age 22.8 months) compared to a 'lower mental age group' who had a mental age of 8.5 months (chronological age 17.6 months). All the children with Down's syndrome went on to produce less declarative pointing than mental age matched typically developing groups. Declarative pointing, the authors suggest, is an indicator that the child is able to represent and influence another's attentional state, therefore an important pre-cursor to developing a theory of mind.

That children can align their mental or emotional state to another's is an important skill in beginning to recognise own and others' internal states, as discussed in chapter 2. Historically, individuals with Down's syndrome have been widely misrepresented as having intact social understanding (Down, 1867) but recent research suggests that social behaviour differences are visible early on (Cebula, Moore, & Wishart, 2010). When children with Down's syndrome were presented with tasks to examine their social referencing (children presented with an unfamiliar and noisy toy, similar to tasks described in Chapter 2) they were found to look less to their carer in the room than typically developing children and they did not always match the emotion displayed by their carer (Knieps, Walden, & Baxter, 1994). For example if the carer looked anxious and scared of a toy, and made vocalisations to this effect, the child would show a positive response. This lack of coordination may prevent the sharing of experiences and set up a complicated carer-child dyad.

Other research suggests that children with Down's syndrome use a predisposition to focus on social aspects of tasks when problem solving. In a range of tests of object permanence and imitation Wright, Lewis, and Collis (2006) found that children with Down's syndrome performed significantly less well than their mental aged matched typically developing counterparts when the possibility to imitate to solve a problem was removed. When the strategy of copying the researcher's actions in order to solve the trial was unavailable, the children with Down's syndrome found it more difficult to successfully find a hidden toy. This was supported by a test of symbolic play where the children with Down's syndrome were more likely to copy the incongruent actions of a researcher (for example, giving a truck a drink) than the typically developing control group. The authors suggest that children with Down's syndrome may be more likely to use imitation as a response to tasks because they have an underlying representational difficulty. This is explored further in section 5.3 of this chapter.

5.2 Pretend and Symbolic Play

The way that play develops in children with Down's syndrome is synchronous with that of typically developing children, albeit at a much slower pace (Beeghly & Cicchetti, 1987). Development of play can be confounded by physical and medical difficulties such as hearing, sight and poor mobility, but in general children with Down's syndrome meet the same milestones in their first 3 to 4 years as typically developing children do in their first 2 years. As play becomes more complex and the relationships between language, play and cognitive development become ever more sophisticated, there may be some underlying differences in the way children with Down's syndrome develop play skills.

The relationship between symbolic functioning and language development in children with Down's syndrome was examined by O'Toole and Chiat (2006). The authors' recognition of the participants' possible use of imitation as a problem solving strategy led them to use a modified version of a task previously used by Bellagamba and Tomasello (1999). The original task showed children a series of toys which the experimenter asked for by either by using a small world version or by using a gesture. For example, a hairbrush was shown to the child with an accompanied gesture of brushing hair. The experimenter then requested the hairbrush from the child by either showing a tiny hairbrush or by repeating the gesture. Adaptations in the O'Toole and Chiat (2006) study included reducing the number of items produced at one time to reduce memory load and using short, repeated sentences. The study concluded that the development of symbolic understanding in children with Down's syndrome proceeds in a similar fashion to typically developing children, with gestures being the easiest to understand, then miniatures and then abstract substitutions. Whilst they may follow the same developmental sequence, the age of the children in this study was 2 years 8 months to 7 years 11 months, much older than the original Bellagamba and Tomasello (1999) study whose cohort was between 1 year 6 months and 2 years 11 months. This may be an important distinction when considering the pretend and symbolic play abilities of school-aged children in comparison to their classmates.

Although supporting an overall similarity in developmental progression to typically developing children, Beeghly and Cicchetti (1987) did find some differences in their studies of symbolic play in children with Down's syndrome. They suggest that children with Down's syndrome may repeat their play activities more, leading to less variation in their play, and that the level of maturity in their symbolic play was limited. This led the authors to suggest that the children in their study played more concretely and found the abstraction of artefacts more difficult. However, they conclude that the representational ability of children with Down's syndrome remains intact and follows a coherent developmental path similar to that of typically developing children.

5.3 Representations and meta-representation

There is a limited amount of research on the way representation may develop in children with Down's syndrome. There may be a presumption that, as precursors to theory of mind appear in a similar fashion to typically developing children, the way children with Down's syndrome mentally represent also functions in the same way as in the typically developing population. Wright et al. (2006), however, suggest that this may not be an accurate picture and propose that children with Down's syndrome may have a representation of tasks and situations which focusses heavily on the social and imitable aspects, rather than on the non-social or pragmatic. Further, they hypothesise that:

"If children with Down syndrome do possess an atypical representational repertoire, they may further compound their deficits by failing to exercise their weaker cognitive skills (Rast & Meltzoff, 1995). This may present as poor consolidation in children with Down syndrome (e.g. Wishart (1993)) or other anomalies in task performance (Morss, 1983; Rast & Meltzoff, 1995). Thus, the activity of children with Down syndrome is arguably driven by a distinct representational basis, which lead to different solutions to tasks, and, ultimately to a different developmental trajectory." (Wright et al., 2006, pg. 447)

The study they refer to (Rast & Meltzoff, 1995) examined deferred imitation and object permanence in children with Down's syndrome aged between 20 to 48 months. Their conclusions describe a possible distinction between 'Hypothetical' and 'Empirical' representational ability. Hypothetical representations are representations of 'might have been', which consider alternatives and allow the child to problem solve. Empirical representations are merely representations of 'what is observed' and so allow no flexibility for problem solving. This could be an important distinction for children with Down's syndrome; if they are unable to store flexible representations they may rely on imitation of the 'empirical' representation in order to problem solve.

5.4 Testing theory of mind

Zelazo, Burack, Benedetto, and Frye (1996) investigated the relationship between theory of mind and rule use in individuals with Down's syndrome use using a range of well-established theory of mind tasks: appearance-reality, false belief, representational change, and a shape and colour card sorting task. The main purpose of the study was to test the specificity and uniqueness claims over the lack of theory of mind in individuals with Autistic Spectrum Conditions. The study included participants with Down's syndrome who had a chronological age range (CA) of 16 – 30.9 years and a mental age (MA) range of 3.9 – 6.3 years. The authors recognise that the mental age of this group is low and compounding this the typically developing children had a CA range of 5.2 – 6.8 and a MA range of 4 – 6.3. The difference in life experiences, interests and desires between these two groups would make finding a task to engage a 'low' functioning 30 year old with Down's syndrome and a typically developing 5 year old in the same way very difficult.

The study found that older individuals with Down's syndrome have *"pronounced difficulty with standard ToM [theory of mind] tasks."* (Zelazo et al., 1996, pg. 484) and that in the rule use card sort activity they either failed to learn both sets of rules or they learnt them but failed to apply them. The authors suggest that the study found much more severe difficulties for individuals with Down's syndrome than previous studies (such as studies comparing those with an Autistic Spectrum Condition and those with Down's syndrome: (Baron-Cohen, 1989; Baron-Cohen, Leslie, & Frith, 1986)) partly because of the older age range and difficulties with vocabulary matching using the Peabody Picture Vocabulary Test (Dunn & Dunn, 1981). Nevertheless they suggest that their outcomes support the claim that difficulties with theory of mind tasks are not unique to those with an Autistic Spectrum Condition.

The difficulty that the individuals with Down's syndrome found however, must be considered alongside a number of other factors which are pertinent to the development of the present methodology. A range of vocabulary was used in the tests including nonconcrete constructs such as 'think' and no mention is given in the report as to how quickly the instructions were given, whether they were only given verbally or how complex they were. These factors may all affect how the participants were able to process and then respond to the tasks. On the card sort and rule switching activity it is possible that typically developing children would have had much more access to and practice of rule learning and switching. Through their everyday experiences of school rules and expectations and they may be more able to switch between different rules for different situations (for example different expectations and rules at home and at school).

Further, the typically developing cohort was drawn from one public school, whereas the Down's syndrome cohort were taken from a range of institutions. The typically developing children will have had some similar and shared experiences whereas the cohort with Down's syndrome will have had a huge range of different supports, interventions and life experiences, across a much longer time. In these respects the two groups are not at all comparable and since theory of mind tests are also using social-cognitive abilities these aspects must be taken into consideration. To draw conclusions from this study may be to prematurely judge the abilities of individuals with Down's syndrome. Although the test scores are clear and the data produced from them supports the authors' claims, there is little discussion in the report of what conditions created the outcomes.

Theory of mind in individuals with Down's syndrome was also considered in a study conducted by Cobos and Castro (2010). The participants were again drawn from a very wide age range of between 5 and 35 years, but were all from one association (it is not clear whether this is an institution, residential or drop in for example) and no mental age is assessed in the study.

Participants were presented with a range of cards (15cm x 20cm) of which they were required to make choices from by pointing. They were given a series of tests which measured their ability to remember and attribute their own and a character's preferences in a number of activities (travel, sport, eating, for example). In all, participants were required to point, or make a choice, 48 times in the testing session. A number of questions present here: after being asked to make a choice that many times, how can the testers be sure that the response was not just automatic repetition of an action? How could the testers be sure that a true 'choice' was being made rather than random pointing? In attributing a character's preference, how could the testers know that the participant was not just remembering the picture on the card they had been shown, rather than attributing preference?

The authors use the term 'putting themselves in his [the character's] place' (Cobos & Castro, 2010, pg. 381) throughout the article; a phrase which would suggest that the participants were able to see the character on the card (Luis) as a real person and attribute thoughts and feelings to him. As Luis was shown only as a picture card, with no social or personal context, it is questionable that the participants would look upon him as a real person.

The conclusions drawn from this task have some limitations as they are based on the notion that being able to remember the preference of a character means ability in theory of mind. The authors argue that in order to know Luis' choice the participants must suspend their own preference, thereby employing theory of mind skills. This rests on the further assumption that participants have made a 'real' personal choice in the first place and not just pointed to something they like at that moment, or a random answer. If their choice was an arbitrary rather than actual preference, they would not have to suspend their choice (as they hadn't made one). The question asked in the study to determine choice was 'Which do you like best?'; an experimenter's understanding of this question may differ greatly to that of an individual with Down's syndrome who is not familiar with the test situation or why the question has been asked (What if the participant didn't like any of the choices? How would they have been able to communicate this?).

The authors suggest that their results show that some training in understanding self and other is likely to improve the development of theory of mind skills in individuals with Down's syndrome, and that explicit teaching of the kind used in their study would benefit this group of people. However it could be argued that training of this kind may merely reinforce the habitual use of imitation and repetition to answer questions and will not utilise the crucial social aspects of theory of mind.

Although the participants with Down's syndrome in the study by Yirmiya, SolomonicaLevi, Shulman, and Pilowsky (1996) are used as a control group, this study is of interest as another indication of the limitations of the matching process. The authors are conscious of these limitations and discuss at length their matching procedures. They matched in a variety of different ways: mental age, verbal mental age and performance mental age, the scores being taken from the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1991). However, similar to that of the two studies discussed above, the chronological age of participants with Autistic Spectrum Conditions, Down's syndrome and mental retardation of unknown etiology (original terminology retained) was between 10.9 and 40.2 years and the chronological age range of the 'normal' group was 5.4 to 11.7 years. Again this raises the question of appropriateness of the task; the deception task in this study used puppet dolls to act out a scene, would this be engaging to both 10 year olds and 40 year olds?

The participants with 'mental retardation' were recruited from *'special schools, occupational centres and programs for people with handicaps'* (Yirmiya et al., 1996, pg. 1005) and the typically developing participants were from local schools. If participants are only selected from specialist institutions it is possible that this selects out any 'higher functioning' individuals who may not be part of these institutions. Further, if the participants are particularly 'low functioning', as their mental age suggests (6.2 – 10.5 years), the verbal presentation of the questions could affect those with weak auditory memory function. When tested on a range of theory of mind tasks the group with Down's syndrome were found to fail more often than the group with mental retardation, but not more than the group with an Autistic Spectrum Condition.

Of particular interest to the present study is the authors' finding that for individuals with Down's syndrome there was very little association between subtest scores on the WISC-R and theory of mind task performance and no cognitive difference between those who passed and failed the theory of mind tasks. This implies that either the measures used in the tests were not sensitive enough, or that the mental age associations which are usually seen in typically developing children's theory of mind abilities may not be apparent in individuals with Down's syndrome. If the second suggestion is true then this raises the question as to whether individuals with Down's syndrome attain theory of mind skills through similar or alternative pathways to typically developing children.

5.5 Working memory in people with Down's syndrome

Difficulties within the working memory (WM) system are a lifelong feature of many people with Down's syndrome. To frame the differences in working memory found in individuals with Down's syndrome this study has taken the revised working memory model from Baddeley (2000) as outlined in Chapter 3. This model has been extensively used across research in working memory and in research into people with Down's syndrome. This model of working memory is particularly fitting to understanding working memory in people with Down's syndrome because offers a clear distinction between the verbal and the visuospatial dimensions. As discussed in Chapter 4, people with Down's syndrome appear to learn better with visually presented materials and visuospatial processing is consistent with general levels of cognitive function (Baddeley & Jarrold, 2007). Verbally presented materials, or that which can be labelled verbally, appear to be more difficult for those with Down's syndrome to process or retain (Lanfranchi, Jerman, & Vianello, 2009).

Jarrold and Baddeley (1997) suggest that an inability to retain and manipulate verbal information stems from problems with the phonological loop system. The limitations of the verbal aspect of WM in individuals with Down's syndrome is shown through research finding typical digit spans ranging between 2 and 6 (E. K.-R. Bird & R. S. Chapman, 1994). Even when spoken numbers are supported with visual aids difficulties persist. Because items which can be verbally labelled are processed using the phonological loop system presenting the numbers visually does not enable improved performance in people with Down's syndrome (Jarrold, Baddeley, & Phillips, 2002).

In contrast, memory functions utilising the visuospatial sketchpad appear to be less affected in people with Down's syndrome and have found to be consistent with other measures of general intelligence (Jarrold & Baddeley, 1997). However recent examinations of separate sub-systems of the visuospatial working memory have revealed dislocations in the way the visuospatial WM system may work in people with Down's syndrome. Lanfranchi, Carretti, Spano, and Cornoldi

(2009) examined the distinction between spatial-simultaneous WM and spatial-sequential WM in children with Down's syndrome. Spatial-simultaneous WM requires remembering spatial locations of more than one object at a time (in their study the starting positions of two frogs on a simple chess board). Whereas spatial-sequential WM requires sequentially ordered information to be remembered (in this case remembering a path taken by one frog on a simple chess board). They found that the children with Down's syndrome performed similarly to their verbal age matched typically developing controls on the spatial-sequential tasks, but below the typically developing group in the spatial-simultaneous tasks. Whilst the reasons for this imbalance are still unclear it may be linked to the way representations are used or because of the dynamic nature of the spatial-simultaneous task process (Lecerf & De Ribaupierre, 2005; Pickering, Gathercole, & Peaker, 1998). It's clear this area requires further research and it does suggest that the common conception that people with Down's syndrome have an intact visuospatial WM function may not be entirely accurate.

Other aspects of the working memory system in individuals with Down's syndrome have also been of interest to researchers. Executive functions (EF), a group of control processes which regulate purposeful attentional systems such as planning, inhibitory control, reasoning, set-shifting and rule use, have found to be impaired in adults and adolescents with Down's syndrome (Rowe, Lavender, & Turk, 2006). Some studies suggest a global impairment in EF in line with lowered cognitive functioning (Lanfranchi, Jerman, Dal Pont, Alberti, & Vianello, 2010), whilst others suggest more specific difficulties. Carney, Brown, and Henry (2013) found that their cohort of individuals with Down's syndrome showed a poorer response than typically developing controls in tasks which measured Executive Load Working Memory *and* required concurrent processing and storage.

A number of studies have further investigated the role of executive functions in people with Down's syndrome. Borella, Carretti, and Lanfranchi (2013) examined how the inhibitory systems may be affected by poor executive functioning. A range of tasks were used to tap into three areas of inhibitory control: 1) Prepotent response inhibition (being asked to subvert a ‘natural’ response), 2) Response to distracter inhibition (how well a more interesting or appealing item can be ignored) and, 3) Resistance to proactive interference (how well interference can be ignored). The children with Down’s syndrome (aged 10 – 19) performed less well in all the tasks than their typically developing counterparts and in particularly in the prepotent and distracter tasks. This group were unable to control distracting information and in particular found it difficult to forget words they had been asked not to remember. The authors suggests that this could lead to the words having a *‘’distracting’ effect, remaining in their working memory, cluttering up its limited capacity.*’ (Borella et al., 2013, pg. 70)

This research is important to the present study not only because children’s working memory efficiency may affect their ability to understand and act on the tasks set, but because of the potential specific links between WM and theory of mind development. As is explained in detail in chapter 3 children’s understanding of others’ mental states goes through a rapid change between the ages of 3 - 5 years and some of this may be down to changes in children’s EF and WM efficiency (Moses et al., 2005; Wellman, 2014). Young children typically fail the displacement false belief tasks by pointing to the place where the toy is currently hidden, not where it was originally hidden, implying that they are unable to supress their prepotent response. This suggests some involvement of their executive functions; as outlined above Carlson and Moses (2001) found that children with better inhibitory control responses performed better on theory of mind tasks.

Given that there may be specific difficulties for individuals with Down’s syndrome in their executive functioning (Rowe et al., 2006), and in particular with their inhibitory control mechanisms (Borella et al., 2013) it can be hypothesized that theory of mind development and in particular false belief understanding may be affected. Whether this is in line with overall cognitive function and therefore a result of mental age or whether theory of mind develops differently than other areas of functioning has yet to be explored. That children with Down’s syndrome were delayed in comparison to their typically developing counterparts in tasks measuring their visual-simultaneous WM (Lanfranchi, Carretti, et al., 2009) may also offer insight into why this group may not perform well on false belief tasks. False belief requires holding two representations in mind whilst choosing the correct (opposite to the prepotent) answer. It could be that the simultaneous nature of this task impacts on the children's WM efficiency to such an extent they are unable to properly process the task. Compounding this may be an inefficient inhibitory response system which does not allow the child with Down's syndrome to control their prepotent response.

5.6 Language and Down's syndrome

Expressive and comprehensive language abilities are very well documented and researched areas of the Down's syndrome phenotype. From the very first written observations of individuals with Down's syndrome a significant difficulty with speech production has been noted:

> *"They are usually able to speak; the speech is thick and indistinct, but may be improved very greatly by a well-directed scheme of tongue gymnastics."*
>
> (Down, 1867, pg.260)

Speech production is generally found to be much weaker than speech comprehension in individuals with Down's syndrome, falling behind expected levels compared to an individual's mental age (Cunningham, Glenn, Wilkinson, & Sloper, 1985; Laws & Bishop, 2003), although some studies show contradictory results (Roberts, Price, & Malkin, 2007; Ypsilanti, Grouios, Alevriadou, & Tsapkini, 2005). Speech production difficulties develop for a number of reasons, both physical and cognitive. Physical differences such as a smaller oral cavity, a large and protruding tongue, large tonsils and poor muscle tone may all affect an individual's range of motion and motor coordination (Abbeduto et al., 2007; Chapman, 1997; Roberts et al., 2007). Issues in production to do with cognition are complex and may be influenced by phonological awareness (Jarrold, Thorn, & Stephens, 2009), limited capacity in the verbal short term memory (Purser & Jarrold, 2005), difficulties in word finding, and speech apraxia (Kumin, 2006).

The development of individuals' receptive vocabulary is of particular interest for the present study. What type of language children with Down's syndrome learn and when they learn it may be of paramount importance for how they are able to develop their theory of mind. Children with Down's syndrome acquire language at a slower rate than typically developing children partly because their speech production is slower and parents tend to match their own vocabulary use to children's production. For children with poor expressive language this may hinder language development as parents may misjudge their child's levels of understanding (Tingley et al., 1994). A further difficulty for children with Down's syndrome may be the way they are able to organise their linguistic systems.

Abbeduto et al. (2003) tested adolescents with Down's syndrome on their receptive language skills. The typically developing children in the study showed correlations between the different tests in word classes, grammar and the Test of Auditory Comprehension Language (Carrow-Woolfolk, 1985). The authors suggest this shows that typically developing children have organised their language system to link up various components and that they are able to use information from one area of linguistic knowledge to progress in other areas. However the young people with Down's syndrome showed no such correlation in their test scores, leading the authors to raise the possibility that *'…their linguistic knowledge may be compromised of poorly organised sets of representations that are only loosely linked'* (Abbeduto et al., 2003, pg. 157). Similarly Price, Roberts, Vandergrift, and Martin (2007) found that boys with Down's syndrome had weaker receptive morphology and syntax skills than typically developing boys who were matched for non-verbal mental age. Although the overall impression is that individuals with Down's syndrome have comprehension skills matched to their mental age, there appear to be particular areas of their linguistic understanding which do not follow this trend.

As discussed in Chapter 3 knowledge of internal state language is implicated as an important element in children's development of understanding the mind. Children learn this language through social means: conversations, storytelling and pretend play. As suggested above, parents are one of the main catalysts in early language learning and the vocabulary the child hears in the home influences speech comprehension and expression (Dunn, 1988). If parents are matching their child directed speech to their child's production they will not necessarily be using age appropriate or comprehension appropriate language.

Beeghly, Bretherton, and Mervis (1986) studied five mothers of children with Down's syndrome and three groups of controls matched on language ability, mental age and chronological age. They found that the mothers of children with Down's syndrome used fewer internal state utterances and less variety of internal state words than any of the control groups. When the mothers of children with Down's syndrome did use internal state language it was often attributed to the child rather than external sources and they used less cognitive state words. The authors suggest that the children with Down's syndrome may *'have fewer opportunities to acquire verbal labels for their own and others' internal states than NH [non-handicapped] children at a similar level'* (Beeghly et al., 1986, pg. 258).

In a similar study Tingley et al. (1994) examined the lexicon of mothers' internal state language to their children with Down's syndrome. They found that, in their sample, typically developing children were exposed to a greater range of internal state words and that mothers of typically developing children use cognitive state terms more often than mothers of children with Down's syndrome. Many of the differences they found could be accounted for by the *child's* mean length of utterance (MLU), however qualitative differences persisted. For example they found that mothers of children with Down's syndrome often used the term 'good' as an inner state label and used very few uncertain cognitive terms (don't think, don't know). The authors suggest that this may be because parents of children with Down's syndrome have a more directive style of interaction (for example Marfo, 1990) and this leads them to interpret the children's experience on the child's behalf. Alternatively, they suggest that parents are tuning in to nonverbal cues of the child or, in the case of uncertain terms, that parents are choosing not to focus on areas of difficulty for the child. Regardless of the reason behind the different use of inner state language, the authors' concern is that if children are given less verbal inner state labels it:

"[…] has potential to impede their understanding of inner states and their appropriate behaviour in response to inner states. At the very least, children with Down syndrome are being socialised to think and to understand themselves in different ways than non-handicapped children." (Tingley et al., 1994, pg. 152)

Of interest here is the knock-on effect this may have for children's understanding of their own and others' minds. If they are unable to correctly understand and label their own inner states they may find it difficult to attribute and label the inner states of others. The children in the Tingley et al. (1994) study were between the ages of 28 and 67 months (2 years 2 months and 5 years 5 months). If children as old as five are not being exposed to internal state terms, particularly cognitive terms such as 'think' and 'know', they may have a limited repertoire with which to comprehend the types of questions asked in the false belief tasks.

5.7 Social cognition and Down's syndrome

As previously highlighted a historical perspective of individuals with Down's syndrome is that they have relatively intact social functions (Wishart, 2007). However, research into early developments in social cognition suggests a more complex interplay between social factors and cognitive development. Moore, Oates, Hobson, and Goodwin (2002) suggest that differences in children's social development may begin with a neurological basis which creates different looking and attentional behaviours and in turn provokes a particular style of maternal input from mothers. They propose that a mother's *'forceful warmth'* (Moore et al., 2002, pg, 47) creates a transaction in which mothers are more likely to take the lead in dyads and triads and the child becomes 'locked into' the mother. The conclusion of this transaction is that the infant becomes reliant on the mother's directional style and therefore makes fewer attentional bids, which affects later abilities in flexible thinking and expressive language. A key concern in their research is the difficulty in developing tasks which capture either the social nature of development or the cognitive.

In a series of studies (Duffy, 1990; Wishart, 1990; Wishart, 1991; Wishart & Duffy, 1990) Wishart and colleagues examined how children responded to traditional object permanence tasks, an emotion recognition task and a collaborative working task (Wishart, 1993, 2007). In collaborative working tasks children with Down's syndrome took a less active role than their more able partners with a non-specific learning difficulty, made less contribution to the task and spoke less. This behaviour was contrary to the finding with typically developing children, who are better at the task after working with a more able partner. The authors suggest that *'the sociability commonly attributed to children with DS may not necessarily extend to contexts in which it might facilitate their own or their partners' learning'* (Wishart, 2007, pg. 1002).

Similarly Fidler et al. (2008) found that children with Down's syndrome appeared to have an uneven profile of social development. They used the Bayley Scales of Infant Development to examine infants at 12 and 30 months and compared them to a group of children with non-specific developmental delay. The children with Down's syndrome made large gains in comparison to the control group in the areas of orientation and social engagement. However this was not matched by progress in emotion regulation and in motor skills and overall mental age. The areas in which the most gains were made were to do with how well the child engaged with the experimenter, suggesting a link with Moore et al.'s (2002) work above which concludes that children with Down's syndrome may be over reliant on adults around them and less task orientated. However Sigman and Ruskin (1999), in a wide ranging longitudinal study of children with Autistic Spectrum Conditions, developmental delays and Down's syndrome suggest that this may not be to the detriment of the child's development; *'[…] the tendency to initiate social interactions with the experimenter is a strong predictor of the tendency to initiate social interactions with peers'* (Sigman & Ruskin, 1999, pg. 103).

Whilst some work has been undertaken on the social cognitive development of infants and young children with Down's syndrome, the social cognitive development of older children is much less documented. Kasari, Freeman, and Bass (2003) examined empathy responses in children with Down's syndrome aged, on average, 9 years old. The children were involved in two scenarios in which their responses were noted; in one the researcher pretended to bang her knee, and in the other they observed puppet show vignettes in which bad or good things happened to the puppets. In the first situation the children with Down's syndrome showed prosocial behaviours such as comforting or patting the experimenter, but in the second situation the children were rarely able to match their own emotion to the emotional state of the protagonist; *'Thus, children with Down syndrome displayed social aspects of empathy, but failed to show emotional/affective components'* (Kasari et al., 2003, pg. 249). The authors suggest that this could be because they were more focussed on the action in the puppet paradigm and they found it difficult to abstract their empathy response. This may be an important developmental issue for individuals with Down's syndrome, particularly when tested using paradigms which call for an abstraction of emotional responses, such as false belief tasks.

A difficulty with social relationships may persist for children with Down's syndrome, particularly as they grow into young adults. Cuckle and Wilson (2002) report that the adolescents in their study of secondary school children with Down's syndrome were unlikely to be involved in social activities at break times, they rarely initiated talk and did not choose to include themselves in groups. They also needed adult direction to help them join in with activities. Whilst this study was not looking at the reasons behind this situation, it illustrates that the 'socially intact' model of the individual with Down's syndrome is not entirely accurate and, as the authors suggest, there is potentially a need for adolescents with Down's syndrome to access specific social learning opportunities.

This chapter has drawn a mixed profile of the theory of mind in individuals with Down's syndrome. What it shows is that the behavioural and cognitive phenotypes associated with

Down’s syndrome may impact in a complex way on an already difficult to decipher process. It is clear that there are many functions which may differ in the individual with Down’s syndrome, potentially leading to a trajectory which is dissimilar to that which is typically seen.

Chapter 6: Study design

6.1 Recruitment and parent/carer involvement

Participants were recruited through contact with regional parent support groups. The support groups put out an initial call for participants through newsletters and email and those interested were asked to contact the researcher or the group for more information. I visited the parent support groups to outline the research proposal and opportunity was provided for carers to ask questions. A detailed Parent Information Pack was sent out to interested parents as hard copies and via email. Two information evenings were also scheduled to give a talk about the research; however these were not taken up by any parents. Most contact with carers was via email. Once written consent was obtained I made email or telephone contact with the school, support group or parent to arrange visits to assess the child.

As part of the engagement of parents and practitioners a further visit to the support groups involved in the study to disseminate findings is scheduled. Local schools which have been involved in the testing process will also be invited (for all contact forms and parent information see Appendix 1).

6.2 Participants

The children, aged between 2 years and 9 years, were split into 3 groups for differentiated assessments. Group 1 was 2 & 3 year olds, n=15, group 2 was 4 & 5 year olds, n=9 and group 3 was 6 to 9 year olds, n=14.

The group 3 age band was much larger than the other two groups because of the nature of the task used. In the original study by Wimmer and Perner (1983), where the false belief displacement task was used (as outlined in Chapter 3), children began to pass the task at around 4 years old, but in very small numbers (only 4 out of 12 children aged 4-5 passed the task). The task has since been replicated numerous times with very many different modifications. In a meta-analysis of 178 studies testing false belief, 60% of children at 4 years old were able to pass, and at 6 years over 80% were able to pass (Wellman et al., 2001). Since this task has not been used extensively with young children with Down's syndrome it was important to ensure potential results at younger ages were not missed (and in fact some of the younger participants in this group produced some interesting results). Using a wide age range enabled examination of the *development* of passing the false belief tasks in this group, not just passes and fails. The call for participants did include children up to 11 years (the end of Primary school) however the oldest participant to come forward was 8 years and 11 months.

Participant	Age at first testing in years.months	Male/female	Seen at
Laurie	2.2	m	home
Frank	2.3	m	centre
Sally	2.5	f	centre
Georgia	2.6	f	centre
Otto	2.7	m	centre
Aisha	2.11	f	centre
Cassian	3.1	m	centre
Annie	3.3	f	centre
Jake	3.3	m	centre
Nora	3.3	f	centre
Henry	3.4	m	centre
Muni	3.5	m	nursery
Gia	3.8	f	home
Hugo	3.11	m	centre
Tabitha	3.11	f	home
	mean= 3.5	m=8 f=7	

Table 2. Group 1 characteristics

Participant	Age at first testing in years. months	Male/Female	Seen at
Daisy	4.5	f	home
Freya	4.7	f	school
Theo	4.8	m	school
Connie	4.9	f	school
Ellie	4.9	f	school
Fabian	4.11	m	group centre
Maia	5.1	f	school
Joel	5.2	m	home
Ollie	5.11	m	school
	mean= 4.9	m=4 f=5	

Table 3. Group 2 characteristics

Participant	Age at first testing in years.months	Male/Female	Seen at
Shana	6.0	f	school
Misha	6.0	f	school
Anna	6.0	f	school
Rose	6.5	f	support group
Morris	6.1	m	school
Pria	6.11	f	home
Alice	7.1	f	school
Laura	7.6	f	support group
Jake	7.7	m	school
Louis	7.11	m	school
Olivia	8.2	f	school
Barney	8.5	m	school
Scarlett	8.6	f	school
Thomas	8.11	m	school
Ruth	8.11	f	school
	mean = 7.5	m=5 f=10	

Table 4. Group 3 characteristics

6.3 Tasks

Group 1 and 2 tasks were chosen and designed to reflect the range of developmental precursors to theory of mind that have been observed in typically developing children. The tasks included have been used with typically developing infants and preschool children, but in the present study they were modified to be used with older children with Down's syndrome. Group 3 were tested on a range of established theory of mind tasks, some of which were modified. Because the overall cognitive development of children with Down's syndrome is slower than that of their typically developing peers (Patterson, Rapsey, & Glue, 2013), to avoid floor effects in the tasks the age of the children attempting the tasks was raised. Tasks were administered to the 2 & 3 year olds in group 1 which had originally been tested on typically developing children aged between 12-18 months. The 4 & 5 year olds in group 2 had tasks which have been used with typically developing 2 to 2 ½ year olds and the 6 to 9 year olds in group 3 had the standard false belief tasks which typically developing 4 and 5 year olds usually pass. Each group had tasks ranging in difficulty to account for the wide range in cognitive profile of individuals with Down's syndrome (IQ range of 30 – 70, Chapman and Hesketh (2000)). It was methodologically important to this study to obtain data from all of the participants, not just those with an 'average' IQ of a person with Down's syndrome, in order to reflect the whole of the Down's syndrome community. It was important to be able work with any variation in abilities and to be sensitive to the fact that people with Down's syndrome are not a homogenous group.

6.4 Task support

The task supports were designed to support the children in an unfamiliar environment and situation. For groups 2 and 3, prior to the session I sent a video to the children introducing myself and showing some of the objects which would be presented in the tasks. These are available to view at:

Group 2 = http://youtu.be/QvubEuPSCx8

Group 3 = http://youtu.be/zysMufCBHNs

Group 1 did not have a video as the testing for this all took place within local support groups (with the exception of 2 children who were both in their own home). In these groups the children were used to working with a number of practitioners in their early intervention groups, so it was considered that the 'stranger' effect would have less impact for this group. The effectiveness of these videos is discussed in chapter 10.

It was important to gain ongoing consent from all the children in the study. A laminated stop card was produced (Figure 5) which I introduced at the beginning of each session. I explained, using spoken and signed language that if the child wanted to stop they could indicate this by tapping on, or picking up the 'stop card'. An evaluation of this is included in chapter 10.

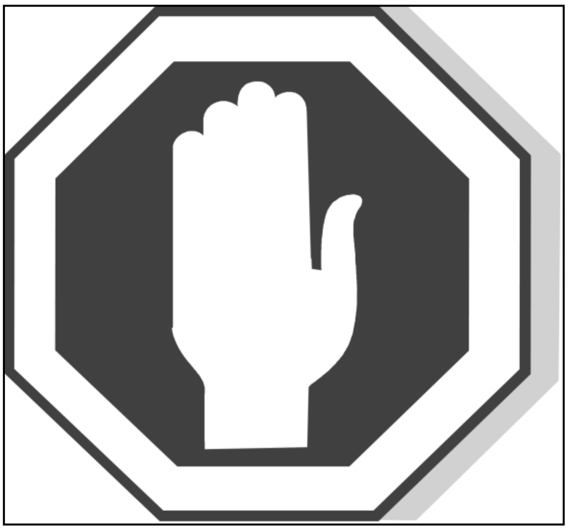

Figure 5. Ongoing consent stop card

The speed of presentation, the style of presentation and the way the tasks were conducted were tailored to the individual needs of each child. For instance, in group 1 the testing session took place on the floor sitting opposite one another in a typical adult/child play dyad. Some participants in the older groups preferred to sit on chairs, whilst some worked on the floor. In one instance Theo had been in his specialist chair for the first visit, but both the parent and I felt he might prefer working on the floor, which indeed did produce much more engagement with the tasks in the second session.

The tasks essentially followed the protocols (Appendix 2) but the speed of presentation was matched to the child's focus and concentration, some tasks were abandoned and the order of tasks was sometimes altered. For example, in Connie's session when the BPVS was brought out she got off her chair and walked to the door to leave. She refused to come back to the table until a different task (the scarecrow) was presented (the BPVS was later re-presented with some success).

6.5 Control group

Early on in the design phase of this study the decision was made not to include any control groups; a number of factors influenced this choice. Of upmost importance was the focus on the development of those with Down's syndrome. To introduce a control group would necessarily turn the research into a comparative study of what each group could and could not do. In previous research individuals with Down's syndrome have been matched with a range of control groups: typically developing mental age matched groups, groups with learning disabilities of unknown aetiology, groups with syndrome specific learning difficulties, groups matched for verbal age, groups matched on visual spatial ability, and so on. In some studies one or more of these matches are made in an attempt to control for, for instance, age or general cognitive delay. Aside from the methodical issues of matching these control groups (Chapman & Hesketh, 2000; Shaked & Yirmiya, 2004), what this does is consider typical development as a standard to compare with. So comparisons are made as to what individuals with Down's syndrome, or other cognitive impairment, can do as well as, or not as well as those with typical development (Wishart & Duffy, 1990).

In this research it was important that the data was treated aside from any comparisons and that the developmental trajectories which could be suggested were considered particular or typical *for this group*. To illustrate this point, take a task from group 2: a pretend play task for the 3 and 4 year olds in this study. If the child with Down's syndrome were to fail this task, it could be concluded that they were working below the level of their 2 year old typically developing counterpart, matched on mental age (MA). However, they may be showing us a number of skills that a typically developing MA matched peer is not; they may be signing, using specific vocalisations, they may use eye contact or body language (or they may not). They may be finding a different way of communicating what they know and what they don't know. If comparisons are always made with typically developing children, it may prevent looking at non-typical children in the right way (Coles, 2001). It was important in this study to find a new 'normal' for these children and to assess them on scales which they, in a sense, create for themselves, similar to the profiling method suggested by Mervis and Robinson (1999). These authors suggest that by comparing within group measures, rather than cross syndrome measures we are less likely to consider a skill (or lack of) as unique and more able to look for within group similarities. This idea also brings into question whether it is necessary to build hierarchies of ability (Goodley, 2001) which have an implicit agreement on which skills are considered to be important.

To be clear, there is no suggestion that this methodological choice is the correct one for all studies of individuals with a cognitive impairment, or indeed of all children. Without controls in studies and standardising we would not be in a position to make the generalisations needed to inform for example, educational policy (if indeed it is your stance that educational policy should be made that way). However the model of comparing 'not like' with 'like' sets up a medical model of learning difficulties which is not acceptable in other areas of disability research (Goodley, 2001). It would not be considered appropriate to compare how fast an able-bodied athlete and a wheelchair athlete could move around a track and then devise a training regime for the wheelchair athlete based on the able-bodied athlete's abilities. Perhaps a more useful experiment would be to look at how athletes similar to the wheelchair athlete move, and to create a new training regime based on that data. In this study the cognitive development of individuals with Down's syndrome is viewed in the same way, this study will compare like with like and consider what is common and uncommon within this group.

However this research does refer to comparisons with typically developing children, and it is recognised that without the prior research of many other authors the position taken here would not be possible. It is only because of the extensive research of others on the development of typical children and the many studies of alternative development that this study can be framed in this way. It is hoped that this research will contribute to the ongoing discussions around child development by beginning to explore a new 'normal' pathway of development for individuals with Down's syndrome and will raise questions about how we (as researchers and educators) consider 'difference'.

Further reasons to exclude a control group were more practical measures. In order to recruit suitable matches it would have been necessary to pre-test all of our participants with Down's syndrome on a battery of tests to measure ability on items such as mental age, verbal or/and non-verbal IQ and language comprehension. Since some children with Down's syndrome have been shown to display avoidant learning styles when attempting difficult tasks (Wishart, 1996) it was important to avoid pre-testing in order to maintain the children's interest in the testing sessions and with the researcher.

To adequately match a control group of typically developing children, the educational and developmental input that the children with Down's syndrome had had, many of them since soon after birth, would also need to be considered. Since the participants were recruited from parent support groups many of the children with Down's syndrome had taken part in early intervention sessions, had home delivered portage or interventions through a hospital (such as physiotherapy and occupational health). These measures could be significant in contributing to individual development, not least because of the amount of 1:1 time with a carer or professional, and would be very difficult to find a match for in the typically developing population.

The time scale of the project was also a consideration when deciding on the research design. If both a control group and a group with Down's syndrome were included each group would have been smaller than in the current study in order to fit in all the testing. Since this research was about the development of children with Down's syndrome, it was felt that keeping a larger cohort of individuals with Down's syndrome was most appropriate.

The inclusion of a control group would however have had some benefits. As the tasks were modified from literature regarding typically developing children it would have been useful to see how the modifications affected a control groups' response. It may have provided some interesting insight into typical development to see whether, for instance, signing the tasks improved performance in this group.

6.6 Task design

Tasks were mostly taken from literature regarding the development of typically developing children and some had also been used with groups with Down's syndrome. By using tasks from other research it was possible to analyse their suitability for children with Down's syndrome and have some reference to how other children had performed on the tasks. Most of the tasks were modified, as explained in the descriptions which follow.

6.6.1 Group 1 tasks

Task	(in order of testing)	Abbreviation	Brief description	Purpose
1a	Object permanence 1 box	OP 1	R hides a toy under a box. Asks child ‘Where’s the toy?’	To assess child’s ability to create simple mental representations which show an object is still in existence even when it is out of sight.
1b	Object permanence 2 boxes	OP 2	R hides a toy under one of two boxes. Asks child ‘Where’s the toy?’	As above
1c	Object permanence displacement	OP 3	R hides a toy under a box, takes the toy and moves it to the other box in full sight of child. Asks child ‘Where’s the toy?’	To assess child’s ability to create simple mental representations which can be updated.
2	Joint attention - bird	Bird task	R shows the child a puppet bird which makes a loud noise. Waits for reaction of child before making noise again or putting puppet away.	To assess child’s understanding of joint attention and their response to an unfamiliar object
3a	Others’ intentions – Doll	Doll task	R acts out trying to pull apart a Russian doll toy. Puts the doll down to allow the child access to the doll. Child’s behaviours observed – do they copy R’s actions?	To assess the child’s ability to determine another’s intent from their actions.
3b	Others’ intentions – Tin	Tin task	R acts out trying to put some discs in a tin but misses the tin each time. Places discs on floor to allow child access to the	As above

			discs and tin. Child's behaviours observed – do they copy R's actions?	
3c	Others' intentions – Teddy search	Teddy search task	R acts out looking for something in a variety of bags and boxes. She points to a picture card with a picture of a brown teddy on it and continues looking. She then stops looking and observes child's behaviour – do they copy R's actions?	To assess the child's ability to determine another's intent from their actions.
4	Others' perspective – Book	Book task	Child sits with carer and looks through a book about baby animals, discussing the animals with the carer. The researcher requests to see an animal 'Can I see the duck please?' Does the child show R the picture?	To assess the child's ability to understand another person's perspective.

R = Researcher

Table 5. Brief description of group 1 tasks

Figure 6. Items used in group 1 OP tasks

The object permanence (OP) tasks (tasks 1a, 1b & 1c) were used as they have formed the basis for many other studies on child development (Wellman, Cross, Bartsch, & Harris, 1986) and other studies examining the development of children with Down's syndrome (Wishart & Duffy, 1990; Wright et al., 2006). The OP tasks were included to assess each child's fundamental ability in understanding that an object still exists even when it is unobservable. This is considered an important ability in early child development because it offers one of the earliest indications that a child has begun to move away from a single updating model of the world, to being able to use simple mental representations to represent unobservable objects. The OP 1c task was included to examine whether the children in the study could follow an object as it moved locations, thereby being able to modify their representation of where the object is (Wellman, Cross, & Bartsch, 1987; Wellman et al., 1986).

A number of modifications were used to aid the children with Down's syndrome access this task. Firstly there was only one trial of each OP task. It has been shown that children with Down's syndrome can revert to off task behaviours if not engaged with the task (Wishart & Duffy, 1990). The OP tasks can be repetitive and so it was decided that to keep the children on task each OP task would only have 1 trial. This does mean that the stability of the children's responses cannot be measured in each session and children who fail on the OP tasks may be doing so because they have not yet adjusted to the task, rather than their lack of ability in the task.

The occluders used in many OP tasks tend to be plastic cups or cloths. Both of these may have caused a difficulty for the present cohort. Plastic cups have an everyday function, which may have distracted from the task. Similarly the sensory nature of the cloths may have proved too distracting for the children. This study used two small shoe boxes with different designs on each to aid the children's visual representation. The lids were removed from the boxes and the boxes turned upside down to hide the toy.

The toys used were a sparkly ball, a red car and a toy dog. The ball was always used first as it was used as an icebreaker toy with the child, the other two were randomly chosen from a box. The objects were chosen as they have distinct and recognisable signs and verbal labels. Many of the children in group 1 regularly took part in early intervention groups which use sign as an early form of communication and were therefore familiar with the signs. Key words were signed throughout the session to aid children's understanding and focus. Exact wordings, signs and timings are given in Group 1 Protocol, Appendix 2.

Figure 7. The 'noisy bird' puppet used in group 1, task 2.

Task 2 was a modified version of a joint attention task by Butterworth and Adamson-Macedo (1987) cited in Charman et al. (2000). In their experiments a noisy mechanical toy was place between the experimenter and the child. Their toy was chosen to *'provoke a mixture of attraction and uncertainty in the child'* (Charman et al., 2000, pg. 486) and the child's gaze switching between either adult (parent or experimenter) and the toy was observed. The task was modified by using a noisy bird puppet rather than a mechanical toy (Figure 7). This enabled control of when the puppet made a noise which allowed enough time for the children's potentially delayed reactions. If a toy had been used which made a constant noise, or only stopped for a limited time, the children with Down's syndrome may not have had enough time to respond. A full protocol for this task is in Appendix 2.

Figure 8. Tin and Russian doll props used in group 1, tasks 3a & 3b.

Tasks 3a and 3b were designed to assess the children's understanding of another person's goal from their incomplete action. Task 3a was a modified version of an imitation task taken from Charman et al. (2000) and Rast and Meltzoff (1995). Both these studies used a range of unusual objects on which the experimenter produces an incomplete action. The child is observed using the objects to examine if he or she acts on the object in the same way, indicating an understanding of the target of the incomplete action. For example, a dumbbell which pulls apart is shown by the experimenter attempting but failing to pull it apart. The child is observed to see if she or he enacts the complete action, even though the end result wasn't seen.

The present version of the task was essentially the same, however the objects differed. Because the children in this study may have had limited fine motor skills objects which were easy to manipulate were chosen (Figure 8). The items chosen were not as abstract at those in the Rast and Meltzoff (1995) study, and may have been familiar to some of the children. This may have led to more success in the task than if completely novel objects had been used. However as some children with Down's syndrome may be adverse to failure or unusual situations (Wishart, 1996), some familiarity with the objects may have helped the children feel confident in engaging with the task.

Figure 9. Equipment used in group 1, task 3c.

Task 3c was an extension of tasks 3a and b. This task involved a collection of boxes and bags (Figure 9) one of which contained a teddy. The child was shown the picture of a teddy and the researcher play acted being confused. She looked between the picture of the teddy and the boxes, looked in 2 boxes, shook her head and looked disappointed. The researcher placed the teddy card in front of the child and waited (full timings are in the Protocol, Appendix 2).

This task was designed to engage the children with a more complex goal task, which involved not only extrapolating the researcher's intention (looking for something), but also projecting a more long term goal (trying to find a specific teddy). The children in group 1 found this task very difficult so it was included in the group 2 (4 and 5 year olds) tasks to address whether it was a task fault or a group/age difficulty. Most of the children in group 2 were able to access this task which suggests it was more likely to be an age/developmental difficulty with the task not a task design fault (this is discussed in detail in chapter 8).

Task 4 was designed to measure children's understanding of other people's perspectives. A simple task was devised which involved the carer and the child looking at a picture book together. The carer was instructed to keep the book upright so the researcher couldn't see the pictures. The researcher sat opposite the carer and child. On a particular page the researcher asked 'Can I see the ducks please?'

In order to show an understanding that the researcher couldn't see what the child was looking at the child needed to either hand the book to the researcher or turn the book around to show it to the researcher. The task was conceived to be familiar and social so that it was a readily comprehensible situation for the child. A key element of analysis coding of this task was to ensure the child was showing *the researcher* specifically, so pointing to the picture in the book was marked as an incorrect response. Also implicated in this task is the language component; a fail in this task may indicate a lack of linguistic competence.

In addition to the tasks the child completed all parents and carers in this group were asked to complete a questionnaire about the language their child used with them and the language they used with their child. As the age group was wide the questionnaires asked about comprehension and sign language as well as any spoken language the child might have. A sample questionnaire is attached at Appendix 3. The words chosen for the children were early key words which referred to themselves or their own needs (for example holding something out to show a carer, or signing/saying 'more'). Parents were asked to indicate whether the children were able to understand the terms, if the child used the terms in sign or in speech. The carers' words were mental state terms which are commonly used, such as 'think' and 'remember'. Parents were asked to indicate how often they used the terms and were given a choice of daily, weekly, monthly or never. Target words were taken from the Down Syndrome Education first 100 words list[2] which indicates the most common first words which children learn to comprehend, sign and say.

[2] Used with kind permission. Available at http://store.dseenterprises.org/collections/types?q=Checklist

6.6.2 Group 2 tasks

Task	(in order of testing)	Abbreviation	Brief description	Purpose
BPVS	British Picture Vocabulary Scales	BPVS	Administered as per author's instructions. R says a word out loud and child is asked to point to the corresponding picture out of a choice of 4.	To assess the child's verbal comprehension level in comparison to a standardised score.
1	Pretend play – Cats task	Pretend play	The child and R play with two toy cats, the child is asked to help give them a drink/food. R manipulates a puppet bird to cause an upset in the sequence of play (spill some milk for example). Child is asked to clean the specific area where the accident has occurred.	To assess child's ability to follow others' pretend play sequences and comprehend a disrupted play sequence. This requires a representational ability which can pretend something is there when it is not.
2	Others' intentions – Teddy search	Teddy search task	R acts out looking for something in a variety of bags and boxes. She points to a picture card with a picture of a brown teddy on it, and continues looking. R stops looking and observes child.	To assess the child's ability to determine another's intent from their actions.
3	Symbolic representation – scarecrow task	Symbolic representation	R and child play with a toy scarecrow. R gives a choice of two non-connected objects (a ball and a	To assess child's ability to use an object to symbolically become something else. This requires a representational ability which is able

	bowl for example) and asks child to 'give the scarecrow a hat' (for example).	to mentally transform an object to be 'something else' which has no connection to its actual purpose.

R = Researcher

Table 6. Brief description of group 2 tasks

The British Picture Vocabulary Scales (BPVS) (Duun et al., 2009) was administered as per the instructions, but with modifications according to individual children's interaction and focus.

Choosing to use the BPVS was a difficult decision. Since language is intimately linked with the development of theory of mind (Astington & Baird, 2005) it was important to have a measure that the older children in the study could access which would assess their level of language comprehension. The BPVS has not been standardised in detail for children with learning difficulties, despite this it is regularly used with children with a range of clinical and learning needs and has been recommended by researchers for children with learning disabilities (Glenn & Cunningham, 2005). However a range of issues specific to testing those with Down's syndrome were apparent before and during testing:

a) *Verbal instructions.* It was a concern that the verbal instructions at the beginning of the test may put the children off from engaging with the task. Many of the children did engage with the test and appeared to understand the instructions. Some however did not, and these children's comprehension abilities therefore do not appear in the present analysis. Some of the children who could not access the test showed levels of comprehension in the experimental tasks which could have been measured by the BPVS, had they been able to access it. (For example they were able to follow instructions such as, 'Can you put the toy in the drawer?'). A further difficulty with the test is that the target word is always verbally presented. This may have presented difficulties for the children with a very low capacity working memory (no participant in the present study had a digit span of more than 3). If the child waited too long before responding, or was unable to use verbal rehearsal strategies they may have potentially lost the target word to working memory decay.

b) *Fine motor skill access to the task.* Difficulties with responding by pointing to the target word were anticipated. For some children this posed no problem, but for others pointing was vague, indecisive or sometimes completely absent. A lack of fine motor skills may have excluded some children from responding and therefore their receptive language skills will not be accurately represented in the present data.

c) *Four picture choice.* It was acknowledged that choosing from four pictures may be difficult for children with poor verbal working memory. The concern was that by the time the child had looked at all the images, the verbal prompt may have been lost. Indeed the looking time before pointing across participants and within participants varied enormously. Children's choice making also varied across and within participants, sometimes a clear choice was made, sometimes they self-corrected and sometimes they pointed to all the pictures on the page (a detailed discussion of this is made in both group 2 and group 3 analyses, Chapters 8 and 9).

d) *Picture discrimination.* Many children with Down's syndrome have poor vision, particularly in the area of visual acuity (Woodhouse et al., 1996). A concern from the outset was that some of the distractor items (pictures which look visually similar to the target, for example a belt and a bracelet) were too visually similar for the children to accurately distinguish between. Similarly pictures which showed action (for example dancing versus walking) may not have enough clarity for the children to pick up on the salient features. For example the dancing picture has small lines near the hands and feet to display movement; the lines are faint and small so potentially not easily seen. In addition these lines are symbolic representations which need to be understood to make the distinction between movement and stillness.

e) *Salient images.* A further difficulty with the picture choice is the occurrence of pictures which are particularly appealing or engaging. Children with Down's syndrome can find it difficult to maintain attention on challenging tasks and may opt to repeat things they know rather than attempt a difficult task (Kasari & Freeman, 2001). Many of the children in this study chose to engage with the researcher about an appealing picture rather than focus on the target word. For example a picture of a child with an ice cream was very often pointed to or commented on, as was an image of a very upset, crying child (neither of these were target words).

In an attempt to limit the effect of some of these potential difficulties modifications were made to the administration of the test. Some words needed to be repeated a number of times before the child would respond and on a few occasions the researcher signed words to aid comprehension. This was usually done to help the child progress through the first few stages of the test. For example, in group 3 one child was unable to point to a ball (which is in the first set of words) and was struggling to focus on the pictures. The researcher asked the child to look at her then repeated the word ball with the sign for ball. The child was then able to point to the correct picture. This was only done where the researcher felt the child was losing focus or was finding the test's practical elements prohibitive to succeeding. The test was also administered on two separate occasions to enable an examination of the stability of the children's performance. A discussion of the children's scores at the two time points is in chapter 8.

Figure 10. Equipment used in group 2, task 1.

Task 1 was taken directly from the Harris and Kavanaugh (1993) battery of tests used to examine the growing understanding of pretence in 18 – 36 month old typically developing children. The task, termed by the original authors 'understanding make-believe transformations' (Harris & Kavanaugh, 1993, pg. 34), was designed to tap into children's understanding of *unexpected* make-believe events. To extrapolate the difference between pretend play which uses representational ability and pretend play which merely 'stands for', Harris and Kavanaugh (1993) devised this task in which the child must follow the pretend actions of an adult which deviates from standard expectations or scripts. For example:

"Episode A. – The props were a teapot and a small towel. The experimenter makes Teddy pour make-believe tea over the pig situated to the right of the child and says, "Oh dear! Can you dry the pig who's all wet?" The child is then given the towel." (Harris & Kavanaugh, 1993, pg. 35)

This sequence was repeated with different substances (tea, toothpaste, cereal and milk) and each time a different area was targeted so that the child had to be specific about where the substance had spilled. The tasks in the present study followed a very similar design with only minor modifications (see Appendix 2 for the protocol). The pigs were replaced with cats which meowed when activated; this gave the researcher the opportunity to engage the children with the task if they were showing disinterest or lack of focus. It was felt that a teddy may not be engaging for a 4 or 5 year old child so the 'naughty teddy' was replaced with a 'cheeky bird' puppet. The bird puppet also made a noise when activated again helping to capture the attention of the participants. The time the participants had to free play with each set of props was extended in order for them to feel comfortable with the props. This enabled the researcher to gauge whether the children knew what each set of props was for before the task proper, if the child was unable to play appropriately with the props then the task was discontinued. The free play situation also set up a play dynamic between the researcher and the child to encourage the children to 'buy into' to the pretence of the researcher. It was felt they were more likely to engage with the researcher's pretend play sequence if they had already been involved in play with her.

The teddy search others' intentions task (task 2) followed exactly the same procedure as outlined in group 1. For the full protocol see Appendix 2.

The symbolic play task, task 3, was modelled on study III by Harris and Kavanaugh (1993), *'Adjusting pretend actions to a make-believe identity'* (pg. 26) and was also influenced by other tests of symbolic play by (Bellagamba & Tomasello, 1999) and the Test of Pretend Play (ToPP) (Lewis & Boucher, 1997). These both make the distinction between pretend play, in which children use small world versions to support their imaginative play and symbolic play, in which children mentally transform objects to take on a new identity. In symbolic play the child must retain the real property of the object whilst maintaining its newly bestowed property (Leslie, 1987). This requires two representations to be held in mind. Arguably this is more complex than in pretend play where the child only needs to create one representation which is tied to the real object (Pratt & Garton, 1993).

In the present study the child was given a knitted scarecrow doll to play with, specifically chosen to be non-gender specific. The child was then given two props to choose from, for example a green ball and some building blocks and asked "My scarecrow is hungry, can you find him an apple?". All key words were signed and the sentence was repeated if the child gave no response after 10 seconds. After a further 10 seconds the researcher said "What can we pretend is an apple?" (see protocol in Appendix 2 for full details). The child could choose either prop, but needed to 'feed' the scarecrow the prop in order to pass the task. This was repeated with 'needs a hat' (target action to put on head), 'wants to write' (target action to hold 'pen' in hand and pretend to write) and 'wants to sleep' (target action to put the scarecrow in a box).

In addition to the tasks the child completed all parents and carers in this group were asked to complete a questionnaire about the language their child used with them, and the language they used with their child. The questionnaire followed the same format as that used with group 1 however the word choices were more complex; a sample questionnaire is attached at Appendix 3.

Adults who were present in the testing were also sent a questionnaire regarding the testing session. The aim was to gather insight into how the adult thought the child had responded and whether their performance was indicative of their usual levels. The questionnaire gave opportunities for comments as well as likert scale questions; an example is attached in Appendix 4.

6.6.3 Group 3 tasks

Task		Abbreviation	Brief description	Purpose
BPVS	British Picture Vocabulary Test	BPVS	The BPVS was administered as per instructions	To determine each child's verbal comprehension level
WM	Working memory digit span task	WM task	The children were asked to point to a sequence of numbers, increasing in complexity.	To determine the individuals digit span
FC	False contents task *not all children were given this task see… chapter 9	FC task	Children were shown a box and asked what they thought it contained, they opened it and then were asked what they had thought it contained before they opened it.	To test for the child's understanding of their own false belief
1	False Belief 1	FB1 - dolls	The FB story was told by the researcher using dolls and props to act out the scenes.	To test the child's understanding of another person's false belief
2	False Belief 2	FB2 – book	An illustration book showing the FB story was 'read' with the child.	To test the child's understanding of another person's false belief

3	False Belief 3	FB3 - digital	The FB story was told with the dolls and props and photos were taken on a tablet computer to record key moments.	As above
4	False Belief 4 *not all children were given this task see chapter 9	FB4 - dolls	The FB story was told by the researcher *or the child* using dolls and props to act out the scenes.	To test the child's understanding of another person's false belief

R = Researcher

Table 7. Brief description of group 3 tasks

The BPVS was administered as per group 2 above.

The working memory task used a proforma taken from a freely available source[3] which was produced by Della-Salla et al as part of a dual task paradigm (Sala, Baddeley, Papagno, & Spinnler, 1995) and is found at Appendix 5. For this task the children were shown a Numicon[4] number line. Numicon is widely used in UK primary schools as a way to teach early maths to typically developing children and those with special needs. It teaches the children to associate a number with a coloured shape and then to use these shapes to work out simple maths. Numicon was chosen as many of the children in the present study would have used the symbols in their learning and may have been familiar with them.

In general digit span tasks require a verbal response, since many individuals with Down's syndrome have difficulty with spoken language (Chapman, 1997) it was felt that asking for a spoken response may put them at a disadvantage. It was hoped that the number line would enable all participants to respond, regardless of expressive language ability. Using the number line however, brought with it a number of difficulties which had not been anticipated (see chapter 9). Aside from using a number line the digit span task was administered as per the instructions. Numbers were verbally presented to the participant and the participant repeated the numbers back to the researcher either verbally or by pointing at corresponding numbers on the number line. The numbers began in sequences of 2 and no participant got further than listening to a sequence of 4.

The false contents task has been widely used in theory of mind research and forms part of Wellman's scale of theory of mind tasks (Astington & Gopnik, 1988; Gordon & Olson, 1998; Thoermer, Sodian, Vuori, Perst, & Kristen, 2012; Wellman & Liu, 2004). In this study children were presented either with a crayon box or with a miniature cornflake packet and asked what

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[3] http://www.ppls.ed.ac.uk/psychology/people/sergio-della-sala

[4] https://global.oup.com/education/content/primary/series/numicon/?region=uk

they thought was inside. After the child's answer the researcher and child looked inside and found a small sock in the crayons box or pencils in the cornflake packet. The child was asked what they thought was inside the packet before they opened it. This task is thought to measure the child's ability to reflect on their own cognition (metacognition) and to recognise that his or her own belief was wrong. In pilot testing the full version of this task was attempted. This requires the child to hypothesise what someone who has not seen the contents of the box would think was inside. In the pilot testing this was unsuccessful and caused much difficulty for the participants, so this element of the task was dropped. Although there is a verbal element to this task it was considered that the participants would be able to respond to the simple question 'What do you think is in here?' using a spoken or signed response. It is not necessary to understand the 'think' element of the question in order to respond appropriately (the question can be responded to appropriately by answering 'What is in here?'). This task was not administered to all of the participants as it was at the end of the test session and some participants had withdrawn consent to continue by this point (see chapter 9).

Figure 11. Items used in group 3, FB dolls task

The false belief dolls task (FB1 –dolls) was taken from versions of the Wimmer and Perner (1983) false belief (FB) task, such as that used in Baron-Cohen et al. (1985), which has become known as the Sally/Anne task. It was necessary to change the names of the protagonists to highlight their gender and to be more memorable for the children. Names were chosen which the children would easily be able to sign, which began with familiar sounds and were easily distinguishable. Sally was changed to Dinah and Anne was changed to Maxi (taken from Wimmer and Perner's original paradigm). The following scenario was acted out using dolls in front of the child: Dinah has a toy. She hides her toy in a drawer and then goes out. Maxi takes the toy from the drawer and hides it in a box. Dinah returns. On Dinah's return the children were asked 3 key questions:

a) Where did Dinah hide her toy (the memory question)
b) Where did Maxi hide the toy? (the reality question)
c) Where will Dinah look for her toy? (the false belief question)

Wellman et al (2001) show that the ordering of these questions makes little difference to whether children pass the final false belief question or not, however (Siegal & Beattie, 1991) suggest that subtle inferences in the way the questions are phrased may influence children's understanding of the questions. For example in some studies the false belief question has been 'Where will Dinah look *first* for her ball?' (Siegal & Beattie, 1991). It was felt that the addition of the word *first* may be confusing to the present cohort and they may not give it the same implicature as adults do. However by omitting the word 'first' there is also the demand on the child to imply the meaning 'Where does Dinah think her toy is?' from the sentence 'Where will Dinah look for her toy?'. A decision to use practical question (where will she look) was made to allow the children opportunity to act out their answer with the dolls if they wished and to maintain a shorter sentence for the children to mentally process.

The story was acted out using male and female dolls and a chest of drawers all taken from the Lego™ Dolls Family Set, a small card box and a small bag (Figure 11). The toys which were hidden were a toy car, a toy baby and toy mole. In task 1 the story was acted out by the researcher using the props and the child watched. The child was not prevented from participating if he or she wanted to. The story was signed with key words using Makaton. Dinah had a different hiding place and a different toy in each of the stories to maintain interest and to aid distinction between each telling of the story. The children were invited to help choose the hiding places in each telling of the story.

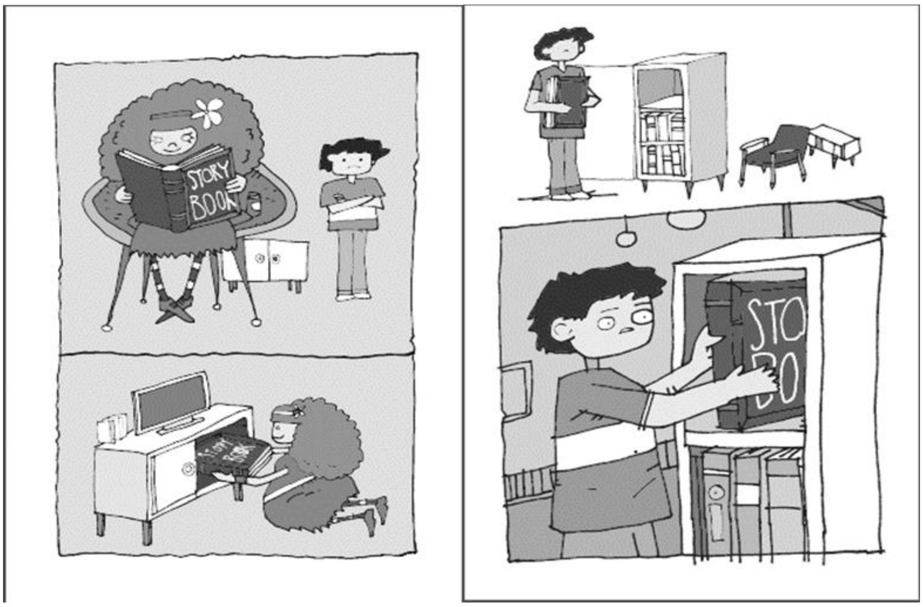

Figure 12. Example from group 3, FB book task (original book in full colour)

For the False Belief 2 task, FB2 – book, an illustrator Matt Ferres[5] was commissioned to illustrate the story in the FB false belief task. (See Figure 12 for example pages, whole book is included in Appendix 6). The book was designed to appeal to the older children in the group who may not want to engage with the dolls. The book was cartoon like in quality and used bold black outlines and engaging strong colours to help the children see the images clearly. The images were

[5] http://www.ferres.co.uk/

purposefully uncluttered but detailed enough to not look like a younger age picture book. The purpose of including a book version of the story was to examine whether this version of the false belief task would give the children in the present study any advantage in comprehending the story and answering the questions.

The Wellman et al. (2001) meta-analysis found that different versions (books, videos, live actors for example) of the false belief task did not make any difference to the age children passed the task. As the current cohort were older than those usually tested and have known difficulties with working memory capacity (Jarrold & Baddeley, 2001) it was considered that a picture book may help to engage the older children more than the dolls of task 1 and that the fixed nature of the story book may help with remembering the story. In this task the researcher and child looked through the story book together, the researcher commented on what was happening in the story and asked occasional questions to keep the child engaged. The 3 key questions were asked whilst the child had the book open in front of them.

The false belief digital task (FB3 – digital) was included for similar reasons to those stated above. A concern with using dolls to act out the story, as in task 1, was that it was not age appropriate for some of the older children. A tablet computer was used to take photographs of each stage of the story. The children were encouraged to be involved in creating the story and taking the photographs. They were encouraged to view and talk about the photographs they had taken. It was hoped that because the children were creating an image of the dolls, much like a stop frame animation or a story board, this removed the element of 'playing with dolls' who instead became their subjects. It was postulated that the children would be able to recall the salient story information more easily because they had created a visual image of the sequence of events. The story was told in the same way as task 1 but with the children taking the lead if they so wished. The researcher provided prompts where necessary to keep the story on track.

The final false belief task (FB4 – dolls) was a repeat of first false belief task (FB1 – dolls) however in this task the children were encouraged to act the story out with the dolls themselves. The researcher gave prompts where necessary or acted out the story where the children did not want to. This task was not administered to all of the participants as it was at the end of the test session and some participants had withdrawn consent to continue by this point (see chapter 9).

In addition to the tasks the child completed all parents and carers in this group were asked to complete a questionnaire about the language their child used with them, and the language they used with their child. The questionnaire was the same at that used with group 2 and is attached at Appendix 3.

Adults who were present in the testing were also sent a questionnaire regarding the testing session following the same protocol as for group 2, attached at Appendix 4.

6.7 Study design key points

This study was shaped by the commitment to a person centred approach which puts the participants' needs at the centre of the design. Modifications to tasks were put in place to help the children feel successful and at ease in the test situation in the hope that this would enable a true reflection of their abilities.

Tasks were designed to allow a variety of ways to respond so that the participants could choose their most effective way of communicating and the researcher's style of interaction was tailored to meet individual needs.

The tasks were structured enough to allow for quantitative analysis of passes and fails, but the testing sessions were also flexible to allow for qualitative analysis of the children's interaction with and outside of the tasks.

Chapter 7: Group 1 results and interim discussion

7.1 Analysis methodology

7.1.1 Quantitative analysis methodology

For each child the video of their session was watched by the researcher and the child's responses to the tasks were scored according to the scoring protocols (Appendix 2). The scoring systems were decided upon during the design phase of the study and were an essential element of recording not just whether each child passed or failed a task, but how they responded to each task. Each scoring system was slightly different according to the group due to the nature of the tasks set, but each system allowed for the recording of passes and fails, number of prompts needed and if off task behaviours or 'no responses' were observed. Quantitative data was rescored for reliability by 2 research students. Scores were at 72% agreement on a small sample (4 children, 10% of the cohort). Differences in scoring were discussed and agreed upon to achieve 100% agreement. Although a wider sample (12 children, 30% of the cohort) was sent for checking, one researcher was unable to complete the checking and one researcher found understanding the tasks (the responses were scored the opposite way round) and understanding the children's responses very difficult. This brought to light the issue that working with children with special needs is a very specific area and that checking data needs specialists who are experienced in working in this area. That two researchers found it difficult to comprehend the children's answers suggests that their scores may not be accurate and so the data validation procedures in this study may not be helpful in the analysis of the data.

After initial pass and fail data were recorded scores relating to the behaviours of the children were examined. Children were recorded as either passing, failing, off task or no response. These were then grouped into all on task behaviours (passing and failing combined as a failed attempt was considered on task), off task behaviours and no responses. This allowed the examination of on task behaviours versus other behaviours. Data was analysed in this way by task, by all tasks combined and by age.

Group 3 data was examined further in that the errors the children made in the false belief tasks were recorded and analysed.

7.1.2 Case series analysis methodology

For the second stage of analysis, video of the sessions of four children from each group were re-examined with a number of foci. Since the tasks gave opportunities to respond in physical as well as oral ways, it was essential that all aspects of their responses were examined in detail. Prior literature on the behavioural and social aspects of functioning in this group (see Chapter 4) reveals a number of areas of potentially interesting foci; eye contact and focus switching, use of sign and speech, use of gesture and pointing, body language and social interaction.

Eye contact and focus switching

One of the earliest skills babies learn is to make and maintain eye contact with others (Carvajal & Iglesias, 2000). The ability to interact with another person in this way eventually leads babies to the knowledge that other people are independent agents who can be manipulated to attend to their needs. Initially children learn to follow a parent's line of sight and this skill develops into the understanding of shared referents (Butterworth, 1995a). Learning to make eye contact with others' is an essential skill in early development; it is the earliest form of social interaction and helps babies to develop a sense of a shared world (Meltzoff, 1999).

Eye contact in babies with Down's syndrome has been shown to progress in marginally different ways to the typically developing child. Carvajal and Iglesias (2000) found that the onset of eye contact was later in than in typically developing infants and eye contact was held for shorter periods of time. In addition, the ability to switch focus between parent and referent has also been seen to be affected in children with Down's syndrome, with children spending a longer time looking to the parent than observed in typically developing children (Berger & Cunningham, 1981).

This may have a substantial impact on the way the child learns; for example if the child is unable to switch focus effectively and quickly between parent and say, a dog, whilst the parent is labelling the animal for the child, the child may not accurately learn the label. Typically developing children are able to use subtle indications to help with labelling new objects (Baldwin, 1993) but if joint attention appears later in children with Down's syndrome (Fidler et al., 2005) then they may be slower to label new objects. If a difference in early eye contact and focus switching is apparent in this group of children it may mean that their learning and knowledge building is affected right from the outset. The qualitative analysis in the present study will examine how these two areas develop and whether there appears to be any continuum across the age ranges.

Use of sign and speech

Children with Down's syndrome are often considered to be 'visual learners' (see chapter 4), as a result of this and spoken language delays many children with Down's syndrome in the UK are taught to use basic sign language (often Makaton™) in infancy. It has become popular for parents of typically developing children to attend 'baby signing' groups as signing is thought to provide a bridge between the pre-verbal and verbal stages of development (Doherty-Sneddon, 2008). For children with Down's syndrome, however, the gap between these stages can be very extended, with some children never achieving comprehendible speech. The difference between what children understand and what they are able to verbally produce can be very marked ((Roberts et al., 2007) and see chapter 4). Is it suggested that parents use sign language with children with Down's syndrome to support children's early language production (Buckley, 2000).

Many of the children in the present study had been exposed to sign language through their involvement with Early Intervention Groups and parent support groups, although exposure is not consistent across the whole cohort.

In this analysis how the children use sign and speech to communicate, how they respond to the researcher using sign and if these areas are different within different age groups will be examined.

Gesture and Pointing

Some recent studies have suggested that children with Down's syndrome use gesture in their communication in a more integrated way than is seen in the typically developing population (Stefanini, Caselli, & Volterra, 2007). It is suggested that gesture supports children's speech and it can help the transition from the comprehension of words to the expression of words (Iverson & Goldin-Meadow, 2005). Studies of typically developing children have suggested that children use gesture during periods of assimilation of new concepts and theories (Alibali, 1999; Carlson, Wong, Lemke, & Cosser, 2005). A delay in using pointing, in particular when used as instrumental requesting, has been implicated as a feature of the early development of the child with Down's syndrome (Kasari, Freeman, Mundy, & Sigman, 1995). The present analysis will investigate and examine gesture and pointing across participants.

Body Language and Social Interaction

As discussed in chapters 4 and 5 the social abilities of children with Down's syndrome may be used in different ways than by typically developing children (Fidler et al., 2008) and social skills may not be generalised in the same way (MacTurk, Hunter, McCarthy, Vietze, & McQuiston, 1985). There may be a range of factors involved in the apparently successful social functioning of this group, not least the ability to imitate effectively (Wright et al., 2006). Fidler et al. (2008) suggest individuals with Down's syndrome may not develop a strong underpinning of the pragmatics of social situations and they may over-use social behaviours in complex tasks.

Through the case series analysis it will be possible to see how the children's body language and social interactions work with, or against, the other elements of their verbal and non-verbal responses. The analysis will allow a description of the social behaviours of the children during different tasks and at different stages of development.

By combining quantative and qualitative analysis is it hoped that a picture of the developmental pathway of theory of mind in children with Down's syndrome will begin to emerge. The quantitative analysis will show what theory of mind skills are developing at different stages across the three groups and will allow for an examination of how the children's off task behaviours may impact on their passing or failing of tasks. The qualitative analysis will offer insight from the children's physical responses showing how the children are, or are not, developing their theory of mind skills in ways not captured in the quantitative data.

7.2 Group 1 – Quantitative analysis

7.2.2 Object permanence tasks.

Participant	Age years months	OP 1	OP 2	OP 3	Pass 3/3
Laurie	2.2	3	3	3	1
Frank	2.3	3	0	0	0
Sally	2.5	-3	-2	3	0
Georgia	2.6	3	3	3	1
Otto	2.7	3	3	3	1
Aisha	2.11	3	0	3	0
Cassian	3.1	3	3	3	1
Annie	3.3	3	3	3	1
Jake	3.3	3	3	3	1
Nora	3.3	3	3	3	1
Henry	3.4	3	0	3	0
Muni	3.5	3	3	3	1
Gia	3.8	3	3	3	1
Hugo	3.11	3	3	0	0
Tabitha	3.11	3	3	3	1

Scoring:
3 pass no prompts
2 pass with one prompt
1 pass with two prompts
0 fail by looking in incorrect place
-1 no response
-2 off task, plays with toys
-3 off task, plays with adults

Table 8. Group 1 Object Permanence tasks, individual children's scores

Fourteen out of fifteen children passed OP1 and 1 child was off task. 10/14 children passed OP2, 1 child was off task and 3 failed the episode by looking in an incorrect place. 13/15 children passed OP3, 2 children failed the episode by looking in an incorrect place. Two children were responsible for 57% of the off task and fail behaviours seen over the 3 episodes. That most children in this group were able to access the tasks indicates that these tasks were within the ability range of the majority of this group. Frank failed 2 episodes and Sally was distracted on 2 episodes, suggesting that for these two participants the tasks were more difficult either to access or to carry out. Both of these children were in the lower end of the age group (2y3m and 2y5m) and both showed off task behaviours in later, more complex tasks.

When all *on* task behaviours (passes and fails combined) were added together the children were on task 95% of the time. From the high pass rate of the OP episodes it can be assumed that they were easily accessed for most children in the group. All of the children who passed did so without any extra prompts which suggests the task instructions were easily processed and acted upon by those who passed. As none of the children needed a prompt to act on the task instructions, it could be suggested that a fail response was due to a lack of representational ability (an inability to represent the object even though it is out of sight), rather than a processing difficulty (which may result in needing prompts to attempt the task).

All of the fails in this task were on the more difficult episodes; OP2, in which there is a choice of 2 boxes (3 children failed) and OP3, in which the toy is moved to a different location (2 children failed). These episodes needed the child to hold in mind a representation of the true state of affairs and in OP3 to mentally manipulate that representation. Since the task instructions were minimal ('Where's the ball?) and all but one child passed the first task, it may be assumed that the processing the task demands were not a major contributing factor to the fails. As the complexity of the mental representation needed increased with each episode it could be that this was a contributing factor. However it should be noted that two of the three children who failed OP2 went on to pass the more complex OP3.

	No response task	**Off task**	**Fail task**	**Pass task**
All OP tasks combined	0%	5%	11%	84%

Table 9. Group 1 Object Permanence tasks, group performance

Ninety-five percent of children were on task (passes and fails combined) throughout the OP episodes, whether trying and failing or trying and passing. This shows that even if the children were unable to achieve a pass outcome they were willing to engage with the activity. Three of the 4 children who failed an episode went on to attempt a further episode, indicating that failure did not prevent them from trying again. Both of the off task responses in the OP task were contributed by one child, Sally, who also displayed similar behaviours in later tasks.

7.2.3 Joint attention – bird task

	Age in years. months	**Joint attention – bird task**
Laurie	2.2	0
Frank	2.3	2
Sally	2.5	3
Georgia	2.6	3
Otto	2.7	3
Aisha	2.11	3
Cassian	3.1	3
Annie	3.3	3
Jake	3.3	3
Nora	3.3	2
Henry	3.4	3
Muni	3.5	0
Gia	3.8	3
Hugo	3.11	3
Tabitha	3.11	2

Scoring:
3 Looks at experimenter to start or stop the bird
2 Looks to parents or carer to start or stop the bird
1 Moves towards or away from object to start or stop
0 No change in behaviour or disengages

Table 10. Group 1 Bird task, individual children's scores

All children except Muni and Laurie responded by looking toward the parent or researcher when the bird made a noise. Although they were instructed not to respond, 2 carers made a noise or showed surprise when the bird appeared which may have confounded these results.

Action	Number of children	Percentage
Look/move toward carer	3	20%
Look/move toward researcher	10	67%
No response	2	13%

Table 11. Group 1 Bird task, group looking behaviour

It could be suggested that the children who looked to the researcher understood that the researcher was in control of the puppet. However a move toward the researcher may also have indicated that the child wanted to play with the bird and so the results in this task are unclear. The video footage does not capture eye contact explicitly; it is therefore difficult to establish whether joint attention has been initiated by the child or whether their movement and looking behaviour is more concerned with wanting to play with the bird. Because of a lack of clarity in the results of this task it has not been considered further in the quantitative analysis.

7.2.4 Others' intentions tasks

	Age in years months	Tin task	Doll task	Teddy search task
Laurie	2.2	3	1	-1
Frank	2.3	3	1	-1
Sally	2.5	-1	3	-1
Georgia	2.6	3	1	0
Otto	2.7	3	3	0
Aisha	2.11	3	3	3
Cassian	3.1	3	3	-2
Annie	3.3	0	3	3
Jake	3.3	3	3	3
Nora	3.3	3	3	-2
Henry	3.4	3	-3	-3
Muni	3.5	3	3	0
Gia	3.8	3	3	3
Hugo	3.11	3	3	0
Tabitha	3.11	2	3	0

Scoring:
3 responds within 5 seconds, attempts to pull apart
2 responds after 1st prompt after a further 5 seconds
1 responds after 2nd prompt after a further 5 seconds
0 picks up object but fails in attempt
-1 does not respond
-2 off task, plays with toys
-3 off task, engages with adults

Table 12. Group 1 Others' intentions tasks, individual children's scores

Ninety percent of children passed both the others' intentions tasks. Three children only passed 1 task, Sally and Henry showed off task behaviours in 1 task and Annie failed to complete the tin task. Three of the 4 youngest children, Laurie, Frank and Georgia, needed 2 prompts to help them complete the Doll task however they did not need this prompt in the Tin task.

The Tin task was potentially confounded by the amount of practice many of the children had had in their Early Development Groups. At Early Development Groups, run by local support groups, children work on their fine motor skills; one of the activities regularly practiced is the skill of picking up an object and then releasing it into a container. As all the children in this group had attended a support group, this may have been a factor for the success rate in this particular task. Rather than the children succeeding in reading the researchers intentions, they may have been using a well-practiced routine of putting objects ‘in’. However that the Doll task was passed just as successfully suggests that some children may have been able to read the researcher’s intentions. The children clearly watched the researcher in her attempt to open the doll and many children produced exacting imitations of the researcher’s movements and sounds as they tried to open the doll. Because of this excellent imitation it is difficult to surmise whether the children understood the intention of the researcher or whether they were able to imitate her action and therefore open the doll as a consequence.

In the Teddy search task the responses were evenly distributed, with more children failing the task, n=5, than passing, n=4. The three youngest children, Laurie, Frank and Sally all showed a ‘no response’ behaviour to the task, all other responses were fairly evenly spread across the participants.

Task	**No response**	**Off task**	**Fail**	**Pass**
Doll	0%	7%	0%	93%
Tin	6%	0%	7%	87%
Teddy Search	20%	20%	33%	27%

Table 13. Group 1 Other’s intentions, group performance

When the passes and fails were combined into ‘on task’ behaviours, it emerged that 60% of children were engaged with the task. Twenty percent of children showing off task behaviour is much higher than found in any of the other tasks to this point in the assessment.

That the Teddy search task revealed a different pattern of behaviours to the Tin and Doll tasks and to the OP tasks suggests that the children found this task more difficult to access and complete. The large proportion of children showing off task behaviours may be due to the children not understanding the requirements of the task. Similarly the high fail rate in this task may also point to a lack of understanding of the task; the children were able to mimic the researcher (they picked up the boxes), but they were unsure of what the researcher's goal was (they did not display any search behaviour). Such behaviour may indicate that those who failed the Teddy search task may have some understanding of mimicking as a tool for learning (watch and do), but were unable to understand another's intention.

7.2.5 Others' perspective - book task

Participant	Age in years months	Book task
Laurie	2.2	-1
Frank	2.3	-1
Sally	2.5	-1
Georgia	2.6	0
Otto	2.7	3
Aisha	2.11	0
Cassian	3.1	-3
Annie	3.3	-3
Jake	3.3	0
Nora	3.3	3
Henry	3.4	-1
Muni	3.5	-1
Gia	3.8	0
Hugo	3.11	0
Tabitha	3.11	-3

3 responds within 5 seconds, turns book to show
2 responds after 1st prompt after a further 5 seconds
1 responds after 2nd prompt after a further 5 seconds
0 points to picture in the book
-1 does not respond
-2 off task, plays with book
-3 off task, engages with adults

Table 14. Group 1 Others' perspective, individual children's responses

	No response	Off task	Fail	Pass
Book task	34%	20%	33%	13%

Table 15. Group 1 Others' perspective, group performance

The book task presents a similar range of behaviour as the Teddy search task. However the overall 'on task' behaviours are reduced to 46%. Notably the behaviour observed the most in this task is no response, at 34%, contributed by the three youngest children in the group, Laurie, Frank and Sally, and 2 other children, Henry and Muni. Only 2 children passed the task; Otto and Nora. In response to the researchers question 'Can I see the duck please?' most children either failed to respond or pointed to the picture in the book (rather than turn the book around to ensure the researcher could see).

The high 'no response' rate may indicate that the demands of the question or task were too high; the children did not understand the meaning of the question and therefore could not respond to it. Most of the children who did appear to understand that a question was being asked of them were not able to respond to it appropriately; of the 7 children who responded to the question, only 2 responded correctly. The children who failed this task pointed to the ducks in the book, but did not turn the book around so that the researcher could see; suggesting that they may not have developed a sense of 'seeing is knowing'.

The linguistic content of this task may also have been too demanding. To understand the difference between 'can I see' and 'point to', may have been too challenging for this group of children; they may have understood the instruction as 'point to the duck'.

Complicating the interpretation of this data is the involvement of the carers. Although instructed not to comment when the question was asked question, some carers made comments such as, 'Show Lucy the book', or 'Where's the duck? Show Lucy', especially if the child was slow to respond to the researcher's question. Clearly such comments could affect the performance of the child, and create a false positive or a false negative. Supported by data from the Teddy search however, it could be tentatively suggested that children failed to succeed in this task because they were unable to see the book from the researcher's perspective. Although they appeared to understand that the researcher wanted to see picture (shown by the children pointing at the duck), they were not able to represent another's perspective.

7.2.6 Group 1, All tasks combined analysis

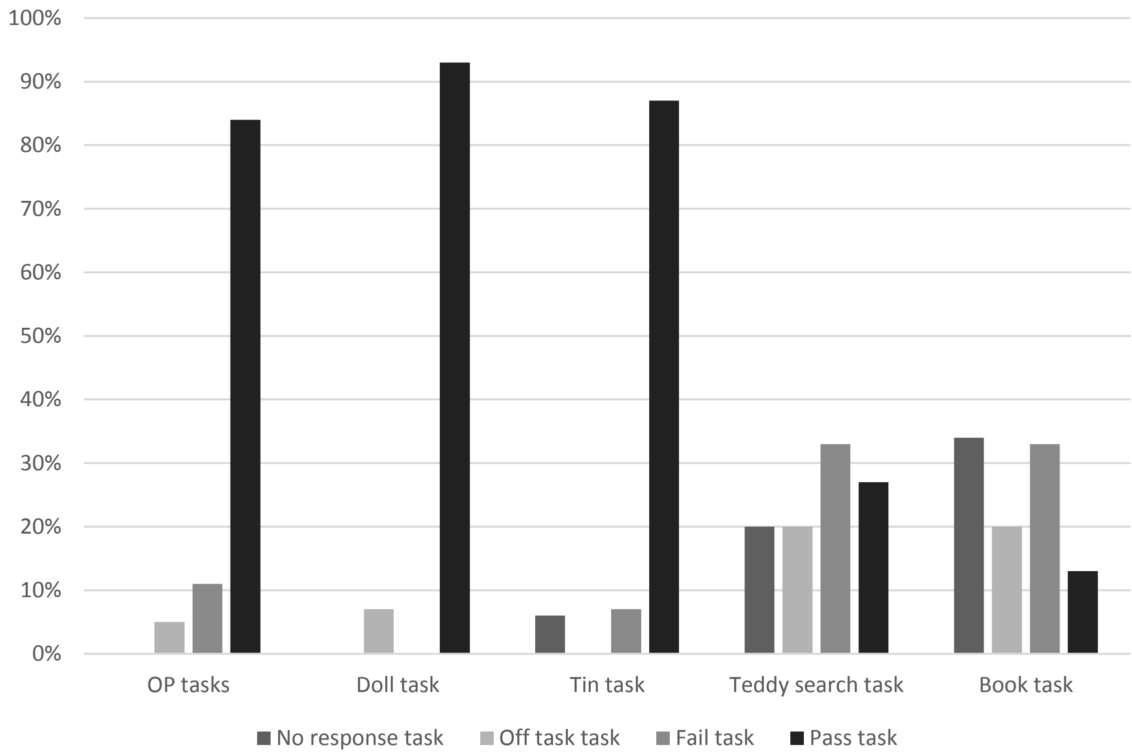

Figure 13. Group 1 all tasks, whole group responses

From analysis of the group 1 tasks it is possible to characterise where this group are in terms of their precursors to theory of mind and also to discuss how behavioural patterns are appearing. Figure 13 shows that the children were most successful at the OP task, which required a simple mental representation of an object, and the Doll and Tin tasks in which the child could use imitation to succeed. In all these tasks rates of off task behaviours were low and the children who failed the task were engaged. Since the pass rates were almost at ceiling in these tasks it would be useful to work with a younger cohort to examine at what point these skills emerge.

In the Doll and Tin tasks the children showed they could use mimicry to achieve a goal and this may be linked to an understanding of others' intentions, however this is not clear from the results. In a typically developing cohort similar tasks would be passed by children of around 15 months (Rast & Meltzoff, 1995). The 2 and 3 years olds in this study could be working at a similar cognitive level to typically developing children of 15 months, but may have reached this point by using a different set of skills. It may be that the children in this study were using imitative learning to develop their understanding of others' intentions similar to those seen in Wright et al. (2006).

Taking the Teddy search task into consideration the patterns become more complicated. As can be seen in Figure 13 the children's behaviours were much more evenly spread, suggesting that the task may have been difficult either to access or to perform. Although the children were able to imitate the researcher pull a Russian doll apart in the Doll task, they did not imitate the researcher looking through boxes in the Teddy search task. This could suggest that in the Doll and Tin tasks the children understood the researcher's intention, but in the Teddy search task the intention was unclear and therefore the children did not imitate. The children may have been using some level of inference of goal detection in their understanding of the tasks. In the Doll task they were able to infer from the researcher's actions that she wanted to pull the Russian doll apart, and so could copy the behaviour to achieve an end goal. However they were unable to infer any goal from watching the researcher look in boxes in the Teddy search task so did not copy the behaviour. It is possible that the children needed to understand the end goal in order to use their ability to imitate; without this purposefulness there was 'no point' to what the researcher was doing.

The Book task shows a very similar pattern of behaviours to the Teddy search task (Figure 13), again suggesting that the children may have found the task difficult to access or to perform. However the Book task used different methods of instruction as shown in Table 16.

Task				
Teddy search	Non - verbal	No instructions	Little interaction with researcher	Success by imitating researcher
Book	Verbal – parent interaction and researcher questioning	An explicit instruction 'Can I see the duck please?'	Interaction with parent	Success by using own knowledge

Table 16. Group 1 Differences between the structure and demands of The Teddy search task and the Book task

Because of these task demand differences, it cannot be presumed that the children displayed similar patterns of behaviour because of the same reasons. There were subtle differences in the way children responded. In the Teddy search task 20% of children showed 'no response' to the task (Laurie, Frank and Sally), in the Book task this increased to 34% (Laurie, Frank, Sally, Henry and Muni). There are a number of possibilities for this. During the Book task the children were sat with their parents sharing the book, when the researcher asked the question she was not part of that shared experience and so the children may have not accepted her question (even though care was taken to get each child's eye contact before the question was asked). There is also the possibility that the children simply did not understand that a question was being asked, or the content of the question. The three youngest children showed 'no response' in the Teddy search task and they also gave this reaction in the Book task. This may indicate that some children in this study showed 'no response' when a task is beyond their comprehension level.

	No response	Off task	On task
2-3 years	15%	4%	81%
3-4 years	3%	11%	86%

Table 17. Group 1 On and off task behaviour, grouped by age

Across all tasks, changes in response appear related to the age of the children. As can be seen in Table 17 on task behaviour remains consistent across age however the younger children were more likely to not respond and the older ones more likely to display off task behaviours. This could be that the younger children were unable to process the demands of the task, and so behaved as though it had not been set. The older children may have been aware of the task and that they were finding it difficult, so possibly displayed off task behaviours to avoid the task. However, as discussed in chapter 4, examining the performance of children with Down's syndrome by chronological age may not be useful because the performance of children of similar ages can be very different (Chapman & Hesketh, 2000). For this set of tasks a more appropriate means of comparison may be between those who passed all the first 6 tasks (Pass 6) and those who did not (No Pass 6).

	N =	Mean age in months	Pass	Fail	Off task	No response
Children who passed all the first 6 episodes	7	38.1	21%	50%	29%	0%
Children who did not pass the first 6 episodes	8	35.3	12%	25%	13%	50%

Table 18. Group 1 Performance in the Teddy search task and the Book task combined, broken down into groups of children who performed at ceiling for the first 6 episodes and those who did not.

Of note in Table 18 is the similar mean age of the two groups. The children who did not pass all the first 6 episodes found the Teddy search task and the Book task more difficult and they were more likely to show no response. More children failed the final two tasks from the Pass 6 group, indicating that this group were more likely to *attempt* the task. However this group were also more likely to produce off task behaviours. These results support the suggestion that those children who were more cognitively advanced (i.e. could pass all the easier tasks) were also more aware of their own limitations when attempting a task and so more likely to display off task behaviours. This group may have an awareness of their own abilities and when a task overreaches them they respond with task avoidance behaviours. That said, some members of this group do also attempt the task and fail, suggesting that they were able to cognitively process the demands of the task, but did not have the necessary theory or knowledge to be successful at it.

Child	Age in years months	Teddy search task	Book task
Georgia	2.6	Fail	Fail
Otto	2.7	Fail	Pass
Cassian	3.1	Off task	Off task
Annie	3.3	Pass	Fail
Jake	3.3	Pass	Fail
Gia	3.8	Off task	Fail
Tabitha	3.11	Fail	Off task

Table 19. Group 1 Performance on the last 2 tasks of the children who passed all prior 6 tasks. Highlighted children passed all prior 6 tasks with no prompts and passed one of the final two tasks.

Highlighted in Table 19 are the three children who passed either the Teddy search task, or the Book task and had perfect scores (needed no prompting) for the prior 6 episodes. These three also attempted and failed one of the last two tasks, rather than displaying off task behaviours. This supports the hypothesis posed that cognitively these children may be in a position to process the task demands, but they are just on the cusp of having the knowledge, experience or theory to pass the tasks. These three children don't display any off task behaviours, potentially because they were engaged with the tasks and felt able to attempt them. Included in Table 19 are the ages of the children, to note is the lack of correspondence of age to failing or passing.

7.3 Group 1 - Case series analysis

In order to get a spread of different responses to the tasks participants were chosen for the case series study using the flow chart in Appendix 7. Age was not a defining factor, however it was important to ensure there was not an artificial age/development relationship in the case series participants. The four participants chosen are shown in Table 20.

Child	Age in years/months	Age in months	Seen at	Attended Early Support Groups	Reason for inclusion in case series analysis
Henry	3y4m	40	centre	✓	Does not pass any tasks
Annie	3y3m	39	centre	✓	Inconsistent passing
Tabitha	3y11m	47	centre	✓	Passes OP and Intention tasks
Otto	2y7m	31	centre	✓	Passes all tasks

Table 20. Group 1 Attributes of the four children chosen for case series study

7.3.1 Eye contact and focus

The ability to focus attention on both the researcher and the task was inconsistent across the four children. On the simpler OP tasks if children were able to switch their gaze between the researcher and the task, they appeared to be more successful at the task. Otto and Tabitha looked from the task to the researcher as she was speaking and back to the task again, before picking up the correct box. The same two children were also able to use focus switching in the Doll task. They looked from the doll, to the researchers face and to the doll again a number of times.

However this ability to switch focus appeared more limited the more the tasks required an understanding of the researcher's intention. In the Doll, Tin and Teddy search tasks all 4 children focussed either entirely on the researcher or on the task, with only brief glances to the researcher. This was particularly apparent where children appeared unsure of the task requirements, such as in the tin task:

Participant	Focus
Tabitha	No interaction with R whilst R leading. When Tabitha self-directs play and puts her foot in the tin she looks directly at R. Then looks back at tin and remains focussed on the tin until the task finished.
Otto	Watches discs as R trying to put them in, but doesn't look at R.
Henry	Doesn't look at R throughout task.
Annie	Doesn't look at R whilst being shown task. Throws discs then looks to R.

Table 21. Group 1 Participants gaze switching in the Tin task

Success in the more complex Tin task relied somewhat on looking to the researcher for social cues about the task; the researcher made a 'disappointed' face and sounds as she was unable to get the discs in the tin. If the child only watched the tin they would have seen a disc being put near the tin; in order to understand that the disc was supposed to go into the tin, the child needed to 'read' the intention of the researcher. One of the ways they could have done this was by looking to the researcher's face. It would also have been possible to work out the intended trajectory of the discs by only watching them as they 'miss' the tin and this may have been the way some children solved this task. However a lack of gaze switching may suggest that rather than using all the information available to them, social as well as practical cues, the children may have been focussing only on the practical aspects of the task.

When working on the Teddy search, Tabitha, Annie and Henry's focus became much more erratic. They switched their focus but appeared to have their own agenda behind their focus:

Participant	Focus
Tabitha	Initially watches R. Imitates her looking. Becomes focussed on bag, plays with it by putting the teddy card in it looks to R whilst playing. Copies R again looking in a box. Becomes focussed on a box and putting the teddy picture card in it, doesn't look again to R until the card is in the box.
Annie	Initially watches R then moves focus to the bag. Says and signs bag whilst looking at R. Focus changes back to box, picks up box and shakes it.
Henry	Focusses on boxes, bangs on them and throws them. Looks briefly to teddy card but not at R.

Table 22. Group 1 Participant's focus in the Teddy search task

From these brief scenarios it seems possible that the more difficult the children found the task the more likely their focus was to become fixed on an element which they *could* interact comfortably with, for example playing with a bag or banging boxes. Just as possible is the reverse hypothesis; the more likely the children were to find an object which took their attention, the less able they were to attend to the task. Only Otto was successful in this search task:

Participant	Focus
Otto:	Lots of gaze switching between boxes and R. Finds teddy, gaze remains fixed on boxes.

Table 23. Group 1 Otto's focus in the Teddy search task

Otto did not look to either the researcher or his mother when he found the teddy which may indicate a lack of interest in the task. However this could also be indicative of a wider issue concerning lack of referential looking. Otto did not check that either adult in the room had seen that he had found the teddy, but praised himself for it by clapping. This follows a wider pattern seen in both the pointing and social understanding analyses later in this chapter. Some of the children do not check to see whether their conversational partner (or in this case play partner) has seen their conversational attempts. As we have seen in earlier chapters (chapters 3 and 5), joint attention relies on the child's ability to check that his or her partner shares the referent. It is possible that the children in this case series had not yet developed this underpinning concept of ‘to see is to know’, leaving children taking conversational or play turns which are unattended to.

From the analysis of eye contact and focus a number of areas of interest have been identified and will continue to be discussed throughout the rest of the analysis:

a. *The ability to switch focus during a task, particularly during the instructional part, may improve children’s success on these tasks.* Children need the ability to watch the task requirements (the practical information) and to combine these with social signals to achieve successful problem solving. The children in this case series may have attempted to problem solve by focussing on the practical information given and not utilising social cues.
b. *An ability to know (and check) that others have seen and understood underpins most social situations.* The children in this study may not have used this theory to help them achieve successful social interactions.

7.3.2 Sign and speech

Child	Sign	Copied	Independent	In task	To change topic	With vocalisation	With speech
Henry	ball	✓		✓		✓	
	dog		✓	✓		✓	
	car	✓		✓		✓	
	cow		✓	✓		✓	
	monkey		✓	✓		✓	
	duck	✓		✓		✓	
Otto	Thank you	✓		✓			
	ball	✓		✓			
	where ball		✓	✓			
	dog		✓	✓			
	looking	✓		✓			
	where gone	✓		✓			
	gone		✓	✓			
	car		✓	✓			
	finished		✓	✓			
	no		✓	✓			
	music		✓		✓		
	rabbit		✓	✓			
	eating		✓	✓			
	elephant		✓	✓			
	cow monkey		✓	✓			
Tabitha	L	✓		✓			✓
	ball	✓		✓			✓
	where	✓		✓			✓
	dog	✓		✓			✓
	watching	✓		✓			✓
	where dog	✓		✓			✓
	car	✓		✓			✓
	ready		✓	✓			✓
	where car	✓		✓			✓
	elephant		✓	✓			✓
Annie	where	✓		✓			
	bag	✓		✓			✓

Table 24. Group 1 Individual participants use of signs

All the children in this case series used sign and some speech sounds, although the amount and how it was used varied (see Table 24). The majority of signs were seen in the OP tasks and were the names of the objects used (ball, car, dog) and the sign 'where'. It was during these tasks that the researcher also used most signs and many of the children's signs appeared in direct response to this. The second most common time for signs to be used was in the story book task where the children signed the names of animals from the book. Signing was limited to nouns and 'where', with very few exceptions. During the doll and the tin tasks no signs were used by any of the children (or by the researcher), with the exception of Otto who signed 'music' to his mum in an attempt to move on from the task at hand. Of notable interest are the different ways in which the children used their signing and how this was associated with their speech and vocalisations.

Use of sign	Focus	Speech and speech sounds
R signs dog Henry signs dog	Looks at R first, then when repeats dog looks to parent	R: What's next? Henry: Ahh dee R: dog Henry: do
R signs dog Henry signs dog	Looks to parent as speaking but then to dog as it is being hidden	R: dog Henry: do

Table 25. Group 1 Henry's use of speech, sign and looking in OP1

On each occasion that Henry used a sign and vocalised during this task he looked to his parent who was sat behind him a few feet away. It appears that for Henry, speaking and signing was a way to gain the approval and praise of his parent, but there was little imperative to use sign for any other reason. For example Henry did not use any signs to communicate with the researcher throughout the rest of the session, until the story book task where he named the animals in the book.

Use of sign	Focus	Speech and speech sounds
	Henry is distracted from mum and takes book from R.	mum: Aaah baby animals
	Continues to look at book, no shift of focus	Henry: Eeee *(monkey)*
cow	Looks to R on name shifts focus between book and R. Does not respond to question	R: Henry, can I see… Henry: Mooo R: …can I see the cow?
monkey		Henry: Weeee *(monkey)* R: Can I see the monkey? Henry: Eeee *(monkey)*
	Looks at pages in book, closes book	Henry: Ba baye. ah di
Duck Duck	Focussed on R throughout this exchange	Henry: Duck R: The duck. Can you show me the duck? Henry: Duck (laughs)
Monkey monkey	Looks up to R when signing, then looks back to book. Looks again to R then to Mum	Henry: Ahheee *(monkey)* R: Monkey? Henry: Aaaheee R: That's a good monkey noise I like that. Mum: Hmmmm R: laughs

Table 26. Group 1 Henry's use of sign and speech in the Book task

Henry appeared to use signs to support his speech as he vocalised on every sign, but there was limited evidence that he had an understanding of this communication as a two way interaction. He communicated by naming animals and objects, but he may have been doing this for the purpose of adult praise, rather than as a conversational exchange. The parent response on his language questionnaire was that he is not yet putting two words together in speech or sign, although he was using imperatives (want and more) in sign. It could be suggested that Henry is at the single word learning phase of language acquisition, however, since children with Down's syndrome are often much better comprehenders than their expressive language shows, this may not have influenced Henry's performance in the tasks.

Otto had a very different pattern of language and communication. He made no speech sounds throughout the entire session, but used sign and pointing as methods to communicate with the researcher and with his mum. In particular Otto made independent communicative attempts to the researcher:

Pointing	Child's use of sign	Focus	Speech and speech sounds
	Looking	Eye contact remains on the dog as it's covered	R: Looking
	Where Gone	Eye contact with R as she asks question	R: Where's the dog
Points with finger onto the top of incorrect box		Looks at box whilst pointing	
	Gone	Looks at R immediately after pointing, whilst signing	R: Have a look
		Looks and moves to correct box and lifts lid. Does not make eye contact with R	R: Oh good boy Mum: He's saying it's gone. I think he was saying it's not in there it's gone. R: Oh it's gone, oh wow.

Table 27. Group 1 Otto's use of speech and sign in the OP tasks

As mum clarified, Otto was saying that the dog was not in the empty box (it's gone) and he was also able to show he knew where it was by consistently picking the correct boxes in this task. This was extra information that the researcher had not requested and was offered independently. The majority of Otto's signs were used without prompts from the researcher and were made before she said or signed a phrase or key word. This indicates that for Otto, the use of sign was much more than an imitative device, he used sign to bring attention to, to name and (in a limited way) offer extra information to the situation. However, how much he recognised that in order for communication to be effective it must be attended to is unclear, as is discussed in the pointing and gesture analysis below. Indeed in his language questionnaire his mother identified that he could put two words together in sign, but was not yet using the term 'want'. This suggests that he could utilise his word knowledge to name and describe, but was not yet confident in using language as a means-end tool.

Tabitha used signing in a different way again; she was more verbally confident than the other participants and used sign only when the researcher did, with two exceptions ('ready' and 'elephant'). All her sign was accompanied by intelligible speech and she often used speech without sign. When speaking or signing her vocabulary was still mostly limited to nouns and repeated phrases; for example 'where' and 'bye-bye', until the exchange shown in Table 28.

Use of sign	Social interaction	Focus	Speech and speech sounds
	Glances to R whilst putting teddy in bag - smiles	Focus on bag – picks it up. Looks in it, takes picture card and puts it in bag.	Tabitha: Bag. bag. ok. oh. oh bag. bag. bag. In. come on teddy.
	Holds bag towards R. Moves it away when R tries to take teddy card.	Looks up to R, then back to bag	Tabitha: Bye bye R: Ok. bye bye. Can I take him out again? Tabitha: No R: Can I have him? thank you
		Watches R as she looks in boxes, but doesn't look at her.	Tabitha: No (in response to R looking in a box)
		Picks up pink box – focus remains on box until teddy picture is in it and lid on.	Tabitha: In a box R: In that box? Tabitha: Yeah R: Hmmm Tabitha: No, it teddy, in R: Oh I see, you want him in, I don't know if he'll fit, he's a bit big. Tabitha: Big. Lid on

Table 28. Group 1 Tabitha's use of sign and speech in the Teddy search task

This conversational exchange shows the Tabitha engaged the researcher as a conversational partner and used the exchange to instruct and control the sequence of play (in this example she moved the play away from the researcher's intended goal to a self-directed goal). She used no signing in this exchange, suggesting that her use of sign in the OP tasks could have been prompted by the researcher's use. Within this sequence she also used 2, 3 and 4 word combinations, an expressive language ability unusual for a child with Down's syndrome of this age. Her language questionnaire reported that her main form of communication is speech and she was 'all the time' putting two word sequences together and using 'want' and 'more' without prompting. However this did not appear to impact on her ability in the tasks; she did not attempt all the tasks and some of the tasks she attempted she didn't complete. It could be suggested from this that when a child with Down's syndrome is observed refusing or failing tasks, it may not be inefficient language which is causing the difficulty. In Tabitha's case it seemed more likely to be either a lack of understanding of the task requirements or a conceptual difficulty which led to failure in the tasks.

Throughout the testing session Annie used two signs and some clear speech. Some of her speech was phrases repeated from the researcher, much was unintelligible to the researcher and she relied very heavily on 'yeah' as a communicative device.

Gesture	Pointing	Social interaction	Focus	Speech and speech sounds
				Annie: (unint)
		Picks up box and tries to hide the car		R: It's ok we've got a car Annie: Got a car R: Oh, are we going to hide it?
nods				R: Can I do it? Annie: Yeah
			As soon as boxes are on floor gaze remains on boxes, doesn't look at R	R: Where's the car?
Holds hands out in 'where' type gesture		Picks up other box and looks under	Looks to R after picking up box	Annie: Ball (picks up box) ball?
	Full hand point towards ball		Looks around R to see ball	Annie: They t'eee

Table 29. Group 1 Annie's use of sign and speech in OP1

As can be seen in Table 29 Annie was able to instigate conversation, based on her own needs and desires (she wanted to find the ball from the previous task). Although she appeared to be finding the hidden car, she was actually looking for the ball and communicated this to the researcher through her speech and a ‘where’ gesture. For much of the rest of the session Annie used one word phrases, mostly in response to the researcher’s questions.

Across the four participants there was a wide range of signing, speech and speech sounds, as would be expected from children who are in the early stages of language development. In the typically developing population the use of one and two word phrases begins in children aged 18-24 months (Roberts et al., 2007). What is of interest is that 3 out of the 4 children primarily used sign to name objects and to copy the researcher. There was little independent signing from Henry, Tabitha and Annie and only a few signs which moved away from the naming nouns. That Otto used sign in a different way may be as a result of his difficulty with speech sounds and may indicate that, whilst many children with Down’s syndrome may only use sign for a short while, perhaps to support their transition into using speech, some may use sign as their primary means of communication for much longer.

Of particular interest are the reasons behind the children’s use of sign. Only Otto used his signing as a way to direct the researcher and to show opinions through using signs such as gone, finished and no. The other three children relied much more heavily on their body language and/or vocalisations to indicate to the researcher their feelings about the tasks. This could be that the children have not yet been taught the signs to express emotions or give directives, or that they have not reached the stage of development where they are able to express these types of communications.

From the examination of speech sounds and signing there are 2 emergent themes which warrant further exploration in Group 2 and 3:

a. *Communication is not always recognised as a two-way exchange.*

Children in this group were not always aware that their communicative attempts needed to be seen or heard in order for the researcher or parent to act upon them. This may mean that they have not yet built an understanding of the dynamic 'to see/hear is to know'.

b. *Communication can be used to redirect the task or situation.*

Even the children with limited speech and sign were able to use their communicative attempts (physical or vocal) to engage with or redirect the researcher. There appeared to be an early understanding that tasks could be avoided through redirection. However, this may contradict the suggestion above that communication is not always recognised as a two way exchange.

7.3.3 Gesture and pointing

All the children used pointing to gain the researcher's attention and all used gestures at some point in their session, although both forms of communication were limited. Otto used pointing the most prolifically and as a specific communicative device.

Gesture	Pointing	Use of sign	Body language	Social interaction	Focus	Speech and speech sounds
Bring LH over in sweeping motion, repeated with RH		Signing no/ finished?			Doesn't look directly at R throughout this exchange	Otto: unint
	Looks and points to LHS of R (to boxes?) To put away?					Otto: unint
Brings LH up across		Signing no/ finished?				

chest to touch RH side						
				Works cooperatively with R to put the doll back together	Does not make eye contact throughout this	
					Makes eye contact	R: Thank you
L Hand point towards R's boxes			Moves top of body forward to lean on RH		Looking at boxes behind R?	Otto: unint
					Watches tin as R brings it out of box	

Table 30. Group 1 Otto's use of pointing during the Doll task

By pointing at the boxes behind the researcher Otto appeared to request that the task be finished and returned to the box or another task retrieved from the box. Otto did not make any eye contact when pointing. He looked at the boxes behind the researcher but did not look at her until she spoke to him. It was not clear that Otto fully understood the functions involved in instrumental pointing; if the recipient of your pointing does not see your point, or the referent, it holds no purpose. Typically developing children point and then check to see whether the adult is following their line of regard, particularly if the adult does not respond to their initial point (Moore & Dunham, 1995). Otto's use of pointing suggests that whilst he may understand that pointing can move a situation on or show a request, he may not be aware that his pointing must be attended to.

Annie also used pointing to steer the session away from a task she was not showing any interest in, however Annie made clear eye contact with the researcher after pointing.

Pointing	Body language	Focus	Speech and speech sounds
	R tries to show dog	First looks away then looks directly to camera	R:Look
Finger point (middle finger?) to the camera		Looks back to R after pointing	R: That’s my camera
	R tries to show the dog again		
Finger point behind her		Looks back to R after pointing	R: That’s the telly
Turns round to finger point the other way behind her		Doesn’t look behind her, but unclear where focus is	R: This…is my dog
	Gets up and walks over to mum (being a dog?) Comes back of own accord		Annie: Woofwoof
		Focusses on dog and boxes	

Table 31. Group 1 Annie’s use of pointing in OP1

Annie appeared to want to distract the researcher away from the task. When the researcher continued the task by trying to redirect to the dog, Annie walked away from the task. Whilst both Annie and Otto seem to understand that pointing is a way to move the situation away from the task, only Annie made the crucial eye contact to check her communication had been received by the recipient.

No pointing was seen from the other two children in this case series, with the exception of Tabitha pointing to pictures in the Book task. There may have been little reason for the children to point since the tasks were directly in front of them. All four language questionnaires stated that the child ‘occasionally’ or ‘all the time’ pointed to something to show it to a parent.

The children’s use of gestures was interestingly absent. Very few gestures were used other than the common cultural gestures of shaking head (for no), holding hands in to body (to show fear) and clapping (for self-praise). On occasion the children directly copied the gestures of the researcher, for example straining to open the doll, or putting hand on chin in a 'puzzled' expression when trying to find the teddy. This imitation may be an indication that the children were trying to 'put themselves in the researcher's shoes' in order to make sense of the task. Alternatively they may have been using a previously successful learning strategy. All of the children in this case series (in fact all but one in the whole of group 1) were enrolled in Early Intervention Groups and one of the strategies in these groups is to learn through imitation. Whilst this is a successful strategy in speech sound learning (copying sounds) and in simple tasks (putting a ball 'in' for example), it may not be helpful when a combination of the social and practical elements of a task both require interpreting. To copy another person's facial expression or action does not lead to an understanding of their intention. All four children's language questionnaires reported that their child 'occasionally' or 'all time' showed distress when someone is upset, showing that they are able to recognise others' emotions. However whether they are able to use this information to understand another's intention is unclear.

From the examination of gesture and pointing there are two emergent themes which will be developed through group 2 and group 3 analysis:

a. *Gesture use appears to be culturally defined rather than used as an addition to language.* Imitation of the researcher's gesture was also prevalent.
b. *Pointing appears to be used to distract the researcher.* However it is unclear whether the children are aware that 'to see is to know'. Declarative pointing has been found to be less proficient in children with Down's syndrome (Legerstee & Fisher, 2008) and our analysis is consistent with this finding.

7.3.4 Body language and social interaction

As it would be unfeasible to reproduce all the children's social and physical interactions in this analysis the results were broken down into two areas which appeared across all four participants: joint attention and the children's responses to the unknown outcomes of the tasks. The discussion of social interaction and body language also brings together the other areas in this case series: pointing, sign, gesture and speech, as all are examples of social interaction.

Joint attention

Throughout the sessions all the children showed signs that they were unable to source and utilise information to help them decipher the task. As discussed above difficulties in switching focus between the researcher and the task meant that at times the child appeared to be only focussing on one aspect of available information. When they did not get enough information from watching the task in order to understand the outcome the child did not, as we may expect, look to the researcher for further clues. For example, in the Teddy search task, Henry seemed unaware of the tasks outcome but did not make any attempt to interact with the researcher who was acting out failing to find the teddy:

Participant	Social Interaction
Henry	Bangs on pink box. Picks up bag and throws it. Focus on boxes, not R Looks at teddy pic as R is pointing to it Helps R open box, R points to teddy pic, Henry glances at pic but main focus on putting lid on pink box.

Table 32. Group 1 Henry's social interaction during the Teddy search task

This behaviour suggests that Henry may not have been aware that there was further social information to be sourced and that this could help him with solving the task. A further interpretation may be that Henry was aware that there was social information available, but he did not have the mental capacity to process the task requirements and the social information at the same time. Some evidence for this is seen in the reverse of the above situation; in this instance Henry was able to copy the researcher's behaviours, but did not replicate the action that was required to complete the task:

Participant	Social Interaction
Henry	Looks to R as she starts activity, watches her attentively. Henry moves as though in exertion – pulls body back. Copies her sound of exertion. Makes eye contact with R as he picks up the doll, smiles. Appears to imitate R, whilst looking at her. Then hands back doll.

Table 33. Group 1 Henry's social interaction in the Doll task

In this example Henry may have thought the task goal was to copy the researcher. After he had done this he handed the doll back to the researcher and then began to engage in off task behaviours.

Tabitha was able to switch her gaze between the researcher and the task (and indeed copied the researcher's gesture), but did not synthesise these two bits of information to understand the task goal.

Participant	Social Interaction
Tabitha	Copies R gesture of looking puzzled – hand on chin Looks directly at R as copying her Watches white box and glances at R. Watches pink box and glances R. Glances to researcher whilst putting teddy in bag - smiles Focus on bag – picks it up. Looks in it, takes picture card and puts it in bag. Holds bag towards R. Moves it away when R tries to take teddy card. Looks up to R, then back to bag Watches R as she looks in boxes, but doesn't look at her face. Picks up pink box – focus remains on box until teddy picture is in it and lid on.

Table 34. Group 1 Tabitha's social interaction in the Teddy search task

Goal detection

The possible information sourcing and synthesising issue evidenced above could also be compounded with a lack of persistence with unfamiliar tasks. All four children had to be encouraged to re-engage with a task (most notably in the teddy search task and the book task) and a variety of off task behaviours were shown during the more difficult tasks. The two most notable behaviours observed were moving the task onto a self-directed form of play and completely off task behaviours. When the children were not engaged with a task they all used the task toys to create their own play. Annie sat compliantly throughout the Doll task, watched the researcher and completed the task, but she behaved rather differently in the Tin task:

Action	Speech sounds
R puts tin down, Annie picks it up, reaches for discs	
Takes disc from R and throws	Annie: Baba *(bye bye?)*
Throws more discs No focus on R – just playing with discs	Annie: makes sounds as discs are thrown
Laughs, looks to R then mum. Then throws more discs	Annie: makes sounds as discs are thrown
Looks to R each time a disc is thrown	Annie: makes sounds as discs are thrown
Points to where discs have been thrown to	Annie: Gada (unint)
Crawls across floor	Annie: Aba (unint)
Crawls around to collect the disks	R: Let me get these ones Annie: Oh, more R: You get that one Annie: Yeah
Walks back to R	Annie: (unint)
Throws discs again.	R: Shall we try it again? Watching, watching
Annie watches as R tries to put discs in. Then throws discs.	
Sees one disc left and goes towards it.	Annie: More

Table 35. Group 1 Annie's social interaction in the Tin task

After the session the Annie's mother told the researcher the child has a similar Russian doll at her Grandma's house to the one used in the task, this may go some way to explain the difference in Annie's behaviour in the two tasks. In the Doll task there was some familiarity for her, perhaps she knew the outcome, but in the Tin task she seemed unaware of or uninterested in the researcher's set goal. Potentially the difficulty in understanding the researcher's goal led Annie to create her own self-directed play in which she was able to be successful and in which she didn't have to work to another's direction.

A similar situation occurred in Tabitha's session. She enjoyed using the researcher's props and making her own game with them:

Action	Speech and speech sounds
Focussed on her own actions – puts doll in tin, tells the R 'nonono' when she tries to remove the doll. Puts doll back in tin. Tries to take discs from researcher (does not look at her) Gaze completely focussed on the toys on the floor – does not look to the researcher for another 60 seconds (until she takes tin and puts it on her foot), even though she engages with her verbally.	Tabitha: Nonononono. There. Right, baaa R: Oh is she going in there is she? I see. Tabitha: Yeah yeah yeah, unint R: Can I do these ones? Tabitha: Yeah R: I'll take her out and put them away
Watches the discs and the tin, but not the R	
Bends down and looks at each disc as they miss the tin	
Lays discs out on the floor, picture side up	
Takes tin and put her foot in it	
Looks up at R after she has put her foot in the tin and smiles – but then does not look again until R starts getting next task	R: Are you putting your toes in? Are you putting your toes in my tin?
Puts second disc in	Tabitha: Oooh der
Puts all discs in	Tabitha: unint (as each disc is put in a sound is made)
Puts tin down and looks to R	

Table 36. Group 1 Tabitha's social interaction in the Tin task

Tabitha had a clear agenda of using the tin as a container firstly for the doll (possibly a bath) and then for her foot. She only engaged with the researcher's goal after she had exhausted her own activity. It is possible that she was practicing working out the task goal by putting a variety of items 'in' the tin. In this instance she appeared to understand the task, but only after taking some time to engage with it. However in the example given in the use of sign and speech section above she is not successful in the task and again uses the toys for her own self-directed play. That Tabitha uses self-directed play in these ways indicates that she may be using it as a way to avoid a task which she doesn't understand, or as a way to bide her time or experiment with the toys as she works out the task demands. Note in the example above however that she does not appear to use any of the social cues from the researcher, she remains focussed on the tin throughout and appears to use the practical elements of the task (there is an empty tin and a pile of discs of the same size) to find the end goal. This strategy would be less successful in the Teddy search task as it is not clear, without comprehending the social aspects of the task, whether the aim is to put the teddy picture card in a box or to find a teddy. This may have contributed to Tabitha's ability to pass the Tin task but not the Teddy search task, even though she used self-directed play in both tasks.

The second behaviour seen where children may not have been clear of the goal or were bored of the task were behaviours which served to distract the researcher. Each child had a preferred way of distracting the researcher, for example, pointing at something, unwanted behaviours, engaging the parent or physical redirection. In the Book task the nature of the activity changed, the child was no longer required to sit opposite the researcher (they sat with their parent) and there were no toys to play with. In the example below Tabitha's behaviour had changed from being sat opposite the researcher and engaged with her, to using mum as a physical barrier to the task.

Action	Speech and speech sounds
Curling into mum, rolling onto the floor, mum encourages to sit up	Mum: What's this Tabitha: Elephant, (unint) stroke
Looking at R, smiling. Curling into mum, swivelling on floor, wriggling around, hand in mouth	R: Can I see the ducks please? Tabitha: No R: Can you show me the ducks? Tabitha: No

Table 37. Group 1 Tabitha's social interaction in the book task 4

It is possible that Tabitha found this task difficult to understand and she was unable to use her previous strategy of using the researcher's props as a means to work out the goal of the task. She distracted away from the task by displaying 'babyish' behaviours which were not seen prior to this task, such as thumb sucking and curling into mum.

Henry also used physical means to disengage with a task. Just before the exchange below Henry had repeated the researcher's words and signs for ball and dog. Each time he spoke and signed he looked at the researcher and then at his mum behind him, smiling and, after signing dog, clapping himself. This suggests that he may have thought the aim of the task was to repeat and sign the words of the researcher.

Action	Eye contact and focus	Speech and speech sounds
Moves straight to correct box, drags it away, lifts it up.	Does not look at R even though she is speaking and comes up next to him.	R: Good boy that was really good looking and thinking. Did you find it? Henry: babbling unint. (Lifts other box) ohhhh
Between activities walks over to the camera, is brought back by R.	Does not respond to R saying his name.	R: Ok, Henry, Henry…
Sits opposite R	Sits down and makes eye contact with R. R points to car	R: Sitting, good sitting, well done…wait…look
	Looking directly at R whilst saying and signing	Henry: Dog
	Looks at R whilst saying and signing	R: Car Henry: Car
Attempts to get up and walk towards camera, is sat back down by R	Looks to R and then to mum	
	Watches car being hidden	
Gets up and runs towards camera – brought back by R.		
	Watches researcher	R: Can you see my red car
	Follows car being hidden	
Attempts to get up again, sat back down by R		Henry: Laughs R: Wait waiting, looking.

Table 38. Group 1 Henry's social interaction in OP1

If Henry assumed that the purpose of the activity was to sign and say the objects shown, then he may not have understood that the researcher had further goal in mind. This confusion is potentially shown by rejecting the researcher's task and physically moving away.

Otto used a different strategy to disengage from a task. As seen in his use of instrumental pointing he used pointing extensively to try to direct the researcher away from the current task. In the example below he used his mum to try and distract away from the Teddy search task.

Pointing and gesture	Action	Eye contact and focus	Speech and speech sounds
		Attempts to put lid back on, focus on box. R helps, then looks in another box.	
	Swivels around to right	Glances at mum	
Points to left of mum (where speakers are)			Otto: uh
Waves both arms at shoulder height, twice (Mum later says he was signing music)		Looks to mum	
	Swivels back round to R after hearing name	Looks at boxes where R is tapping	R: Otto
		Takes picture of teddy	
Claps		Opens box, and puts picture of teddy in. Does not make eye contact with R	
Claps		Closes box	

Table 39. Group 1 Otto's social interaction in the Teddy search task

Otto attempted to open two boxes before the distraction and later clapped himself for putting the teddy picture in a box. This could indicate that his perceived goal for the task was more about opening boxes (and perhaps putting an object in) than finding the teddy. Otto may have been using a distraction technique to finish the task and move on to something he found more appealing (the music).

Annie uses a mixture of strategies to finish or avoid the tasks set; she uses pointing on two occasions to try and distract the researcher and she also uses physical means to stop the task (walking away, putting head on floor and spinning around).

Themes which have emerged from examining body language and social interaction, and which will be taken through to the group 2 and 3 analysis, are focussed on the way the children used social means to comprehend and disengage from the tasks:

a. In this case series the children had difficulty either initiating and maintaining joint attention or fully utilising the information gathered during joint attention.

b. *All the children in this case series disengaged from the tasks*. It is proposed that disengagement arose from a difficulty in perceiving the researchers goal and acted as either a means to finish the task or to bide time whilst the task goal is worked out.

7.4 Group 1 - Interim discussion

The children in group 1 made a wide range of responses to the tasks, observable in both the quantitative and qualitative data. The quantitative data alone suggests some uniformity of response, however the qualitative data describes a varied picture of the mechanisms children used to address or reject tasks. By bringing together the two types of data it is possible to suggest a tentative developmental pathway on which the children in group 1 can be situated.

At the end of this chapter Figure 14 gives a brief description of the changes in social understanding observed in this group and Table 40 describes these changes in more detail. It links observed behaviours to both types of data and to underlying mechanisms of prior knowledge, representational ability and executive functioning and working memory. The discussion below expands on these points suggesting a tentative developmental pathway and suggesting why the behaviours observed may be occurring.

Some of the children in this group showed behaviours which suggested their understanding of the tasks was fixed on the currently observable state. This narrow range of observation enabled the child to focus entirely on the task set and be unaware of possible distractions, but conversely did not support learning through or about joint attention. A child fixed on the currently observable state may use imitation to attempt tasks and may perceive imitation as the end goal (for example, copying the researcher's movements and facial expressions when trying to open the Russian doll). A fixation on the current state means that the tasks which require a projection of a long term goal, or an understanding of others' perspective (the Teddy search and the Book tasks) are not understood as problems which have a goal and so produce no response from the child. Children can work at this level by having prior knowledge of the existence of objects. They may also have some schemas which represent praise as a positive reinforcer and imitation as a means end strategy. Representational ability is restricted to an empirical account of what is currently observable (Rast & Meltzoff, 1995) and is not shared amongst domains (Karmiloff-

Smith, 1995), limiting the ability to draw on information from other domains in problem solving. This may explain the use of imitation as a way to solve the Tin and Doll tasks, as children were relying on what was directly observable to solve the problem (the researcher's actions), rather than drawing on other resources (such as knowledge about forces).

The child's executive functions may further constrain responses to the tasks. Difficulties with concurrent processing and storage (Carney et al., 2013) may limit the amount of information which can be processed and held in mind, compounding the propensity to focus on the here and now. However as Lanfranchi, Carretti, et al. (2009) found sequential spatial elements of working memory were consummate with mental age, it is possible that this element of working memory is supporting the child in representing objects which are not visually available (as in the OP tasks). In their study sequential spatial working memory was tested by asking participants to follow the path of a frog moving around a chessboard and remember certain steps. This skill may enable the child to follow sequential tasks such as the OP tasks, as they can visually represent the last place (or step) in the hiding sequence. Using this ability may help them overcome the concurrent processing and storage difficulties found by Carney et al. (2013).

A change in the children's behaviour toward the tasks appeared to coincide with an ability to switch focus between the researcher and the task. It is possible that when the children were more aware of information aside from that which was immediately in front of them (i.e. the task) they were also more aware of a requirement to achieve or pass a task. Children who were able to focus on the researcher as well as the task appeared more likely to display unwanted behaviours. It is possible that children at this point are beginning to develop a schema of 'failure' and that this provokes behaviour to distract away from a task they feel they may fail. This suggests that their representational ability is developing to be able to predict a future state, possibly moving towards a dual representation model (Perner, 1991) or level E1 according to

Karmiloff-Smith's (1995) model. Concurrent processing and storage difficulties may continue to constrain the amount of information able to be processed.

A next point of development observed in this study was as the children developed object play skills and used them skilfully to distract away from or work out the task at hand. For example when Tabitha used the tin to put the doll and her foot in she may have been activating her prior knowledge of 'in' and working through a variety of objects to put 'in' before she was able to determine the researcher's goal. Perseverance amongst the children at this point in development was high and although they still used imitation to access the task, they showed persistence in attempting the tasks. Play schemas appeared to be pervasive in children at this point in development as they produced off task behaviours which were focussed on playing with the toys. This may be that the children's early pretend play skills were showing as their representational ability became hypothetical (Rast & Meltzoff, 1995) or they were able to use dual representation (Perner, 1991). Difficulties with inhibitory control (Borella et al., 2013) may also be implicated at this point in development as prepotent responses, such as self-directed play, were uninhibited.

The children who were the most successful in the tasks may have had the most well developed joint attention skills and underlying schemas. These children were able to switch their attention between the task and the researcher and were most likely to attempt the last two tasks (Teddy search and Book tasks) and pass one of them. These children appeared to be developing an understanding of other people, shown through their purposeful communication such as declarative pointing and joint attention. Underlying schemas of goal comprehension may at this point of development support children's understanding of others as intentional agents (recognition of others' goals) and their understanding of intentional communication (communication which has a purpose or goal). However children at this point are still working at a representational level E1 (Karmiloff-Smith, 1995) and they have not yet moved on to metarepresentation. This is evidenced in the inconsistent responses seen in the Teddy search and the Book tasks. A metarepresentational ability would allow the child to recognise the researcher had a different physical point of view in the Book task. It would allow for multiple representations to be made: 1. the child's own view, 2. the researcher's physical view, 3. the position of the book *and* it would have the flexibility for the child to manipulate these representations, using their underlying goal detection schema, to work out a possible solution (turn the book around). Development of representational ability may be constrained by the simultaneous spatial working memory. Lanfranchi, Carretti, et al. (2009) suggests that this aspect of working memory does not function efficiently in individuals with Down's syndrome and may affect the ability to process simultaneous spatial information. The Book task and the Teddy search task both require the mental manipulation of a physical object located in space (the book or the teddy) in order to solve a problem, without an efficient simultaneous spatial working memory this may not be possible. Continued concurrent processing and storage difficulties (Carney et al., 2013) may also compound this.

Outlined above is the progressive development of early theory of mind skills seen in the children in group 1. An increase in their prior knowledge and their schema building is observed, but continued restrictions are placed on both of these mechanisms by difficulties with executive functions and working memory. An inefficient imitative learning style also seems to be apparent and persistent in this age group, supporting prior conclusions in this area (Wishart, 2001; Wright et al., 2006). Joint attention and declarative pointing are areas of weakness which undermine the children's ability to access the tasks and to utilise all the information available to them, this is a finding consistent with some prior studies (Legerstee & Fisher, 2008), but not others (Fidler et al., 2005). The children who passed the most tasks used joint attention and declarative pointing to engage in purposeful communication, but this was not tied to age. Whilst there was some increase in passing tasks with age this was not consistent across the group. Passing the easier tasks *without prompts* appeared to be a much better indicator of whether the children would attempt (but not necessarily pass) the more difficult tasks. Table 40 outlines the possible trajectory of the early theory of mind skills and social cognition of the children in group 1. There are purposefully no age boundaries on the figure, because of the non–uniformity within our group in terms of age and ability. The arrow however indicates the direction of development.

7.4.1 Group 1 - Simple description of the development of theory of mind skills observed

Increase in complexity of cognitive skill →

Empirical representations based on what is observable

Imitation as a goal
Joint attention in tasks which are understood

Representations able to take on hypothetical situations

Imitation as a problem solving strategy

Some awareness of own ability

Unable to project long term goals

Representations developing – dual representation
Continued use of imitation, although perseverance now seen
Self-directed play overrides task set

Awareness of own success and failure
Joint attention not yet secure

Representations moving towards, but not yet at meta stage
Sense of achievement when persevering with task, leading to securing of goal schema
Other people as communicative partners
Others as intentional agents
Use of declarative pointing and joint attention in communication and problem solving

Figure 14. Group 1 Simple description of the development of theory of mind skills observed

7.4.2 Group 1 - Synthesis of qualitative and quantitative data and prior research

Qualitative and quantative data linked to prior research →

Increase in complexity of cognitive skill ↓	Description of qualitative behaviours observed	Description of quantitative findings	Prior knowledge and schemas	Representational ability	Working memory and executive function	Development of social cognition/theory of mind
	Gaze switching apparent in object permanence tasks Little gaze switching in others' intentions and perspective tasks Main focus on task not researcher Looking to others for praise Imitation of researcher seen as a goal, access to praise	High pass rate and no extra prompts needed in OP tasks Very few off task behaviours shown throughout session Use imitation to pass 3a and b others' intentions tasks Younger children show no response in tasks 3c (teddy search) and 4 (book) Engaged with tasks regardless of passing or failing	Schema for 'objects existence even when they are not observable' Performance or imitation = praise Simple language = nouns and verbs	Empirical representations which are tethered to the present No ability to call up previous representations	Concurrent processing and storage not efficient Able to use sequential spatial working memory to support task demands	Fixed on what is observable therefore success is achieved through imitation Uses inappropriate or old schemas to tackle new problems (imitation) Unable to form goals from others' actions because of use of imitation as a strategy Joint attention in tasks which are understood, but not used in difficult tasks

	Child distracts away from task by using physical distance and unwanted behaviours Usually focused on either the researcher or the task Some limited focus switching Relies on imitation to attempt others' intentions tasks	Off task behaviours seen in last two tasks by those children who passed all first 6 episodes with prompts Use of imitation to attempt tasks 3a and b, others' intentions Older children showing off task behaviours	Emotional schema for correct/ incorrect performance	Representations still empirically based Used to call up prior experience of failure Representations able to be used by a number of domains	Concurrent processing and storage not efficient Able to use sequential spatial working memory to support task demands	Has developed awareness of own limitations (I know that I don't know) due to prior successes and failures, leading to off task behaviours Cannot project forward a longer term goal Use of imitation as a problem solving strategy
	Child distracts away from task using self-directed play Erratic focus shifting (is easily distracted) Relies on imitation to attempt others' intentions tasks, however can persevere and gain success Able to self-satisfy—eg. makes up own goal for task, congratulates self	Pass all 6 prior episodes without prompts, attempt but fail last two tasks Younger children need prompts to attempt doll task Attempts book task but points to picture in book rather than turns book around	Goal schema in development Play schemas more prepotent than task requirements	Hypothetical representations beginning to be formed—allowing for goal detection	Concurrent storage and processing not efficient Inhibitory control not efficient and lets play schema overwrite task requirements	Growing sense of self and awareness of own successes Own play is more interesting and important than task set Continued use of imitation to solve problems, however with goal detection now available perseverance is seen Joint attention is not well established

	Successful focus switching between task and researcher Others' goals are attended to Attempts to use others to move on from task (purposeful communication)	Pass one of the last 2 episodes after passing prior 6 episodes with no prompts and no fails Attempts last two episodes, regardless of passing or failing	Goal schema established Communication as a 2 way device	Hypothetical representations continuing to be developed, but do not yet support meta representation	Simultaneous spatial working memory inefficient - so unable to represent 2 spatial possibilities in last 2 tasks	Sense of achievement when persevering with task, leading to securing of goal schema Developing sense of other people as communicative partners Developing sense of others as intentional agents

Table 40. Group 1 Synthesis of qualitative and quantitative data and prior research

Chapter 8: Group 2 results and interim discussion

8.1 Group 2 - Quantitative analysis

8.1.1 British Picture Vocabulary Scales (BPVS)

The BPVS was included in the tests for this group to gather information about each child's language comprehension ability. As discussed in detail in Chapter 6 there were concerns over how reliable this type of test would be with children with Down's syndrome and as such the results of the BPVS should be treated with some caution. On the administration of the test, in both groups 2 and 3, it was clear to the researcher that many of the children knew much of the vocabulary they were tested on, but were unable to respond appropriately to the test. This is discussed along with group 3's responses in Chapter 10.

Participant	**Age in years months**	**Raw score T1**	**Raw score T2**	**Average of T1 and T2**	**Difference between T1+T2**
Daisy	4.5	47	41	**44**	-6
Freya	4.7	12	10	**11**	-2
Theo	4.8	-	**-**	**-**	-
Connie	4.9	19	24	**22**	5
Ellie	4.9	26	29	**28**	3
Fabian	4.11	28	24	**26**	-4
Maia	5.1	29	22	**26**	-7
Joel	5.2	11	23	**17**	12
Ollie	5.11	37	27	**32**	-10

Table 41. Group 2 BPVS raw scores at T1 and T2

To try and capture an accurate picture of the children's verbal comprehension levels the BPVS was administered at both testing points for all the children in group 2 and 3. The results for group 2 shown in Table 41 support the claim that the BPVS may not be a reliable tool for children in this clinical group. The table reports each participant's performance at T1 and T2 and shows the difference between the two time points, which were no more than 3 weeks apart. Five children got lower scores at T2 and 3 children got higher scores at T2. One child was unable to be tested; although the test was presented he did not, or could not participate in it. The average difference between testing points was 6 raw score points, for some children this made a difference between being able convert the raw score to a standardised score, or not.

Table 42 shows the raw and standardised scores for all the participants in group 2. Three children reached a raw score high enough to standardise at T1, and 4 at T2 (2 of these being different children than at T1). Because of these marked differences in children's performance at the two testing points the average raw score from the two tests has been used throughout the analysis. As described in detail in Chapter 4 there may be a number of reasons for children's poor performance in this test; lack of experience in a test situation, lack of knowledge, medical and health issues, focus and concentration issues, memory function difficulties and fine and gross motor difficulties. Averaging out scores across the two time points may allow for some of these difficulties whilst at the same time not over estimating each child's abilities (as could be the case if only their best score was used). Because only 5 children were able to have their scores standardised each participant's raw score was used for analysis.

Participant	Age in years months	Raw score T1	Standardised score T1	Percentile T1	Age equivalent T1	Raw score T2	Standardised score T2	Percentile T2	Age equivalent T2
Daisy	4.5	47	91	28	<3.9	41	88	22	<3.9
Freya	4.7	12	-	-	<3.9	10	-	-	<3.9
Theo	4.8	-	-	-	-	-	-	-	-
Connie	4.9	19	-	-	<3.9	24	70	2	<3.9
Ellie	4.9	26	-	-	<3.9	29	73	4	<3.9
Fabian	4.11	28	72	2	<3.9	24	70	2	<3.9
Maia	5.1	29	70	2	<3.9	22	-	-	<3.9
Joel	5.2	11	-	-	<3.9	23	-	-	<3.9
Ollie	5.11	37	-	-	<3.9	27	-	-	<3.9

Table 42. Group 2 BPVS raw and standardised scores, T1 and T2

8.1.2 Pretend play – cats' task.

Participant	Age in years months	BPVS average raw score	Pretend Play Pass 1 Fail 0
Daisy	4.5	44	1
Freya	4.7	11	0
Theo	4.8	0	0
Connie	4.9	22	1
Ellie	4.9	28	0
Fabian	4.11	26	1
Maia	5.1	26	1
Joel	5.2	17	0
Ollie	5.11	32	1

Table 43. Group 2 Pass and fail rates in the pretend play cats' task.

Five out of 9 children passed the pretend play task (passed 3 out of 4 episodes). Of the 4 who failed 3 were due to incorrect responses and 1 was due to off task behaviours. Across 35 trials in this task only 1 off task and 2 no response behaviours were shown, giving an extremely high level of engagement from this group (91% on task behaviours). One child who passed needed prompts to help them engage or access the task. Given the high level of compliance with this task, it could be assumed that most of the children found it engaging and it held their attention across the four trials. Many of the children appeared to engage with the task on a social or moral level, telling the cheeky bird off or trying to act out the cheeky bird themselves. They showed a delighted dismay when the bird caused a mess and were happy to be involved with the storyline. However, when those children who failed the task are investigated more closely, it is possible that the task may not have been as accessible as it was engaging.

Three of the 4 children who failed the task, and the child who needed extra prompts were all under 4 years 9 months. Three of the 4 children in the whole group aged over 4 years 9 months were able to pass the task. Although the make-up of these two age groups was different, with 4 children aged 4 years 11 months and over and 5 children under 4 years 9 months, it can be tentatively suggested that there is some relationship between age or maturation and the children's abilities to process and access the task.

However, Daisy, who was the youngest in group 2 at 4 years and 5 months, performed at ceiling on this task. Her BPVS average raw score was also the highest in group 2 (44), suggesting that success on this task may have been moderated by some degree by language comprehension. Indeed the instruction 'Can you clean where the bird has spilt the milk?' may be easily misunderstood as 'Can you clean the milk?' a rather less specific instruction. As working memory is implicated in speech and language difficulties in this population (Jarrold & Baddeley, 1997) it may be that the children's working memories did not support the retention and comprehension of the instruction given.

Although neither age nor average scores on the BPVS are consistently related to success in this task, as is illustrated in Table 43, the children with the lower BPVS average raw scores tended to fail the task and the children with BPVS average raw scores over 22 tended to pass the task. This finding is in accordance with the above hypothesis that the task relies heavily on understanding a verbal instruction. Those children with the lower BPVS scores may have found the task difficult not because of the nature of the representations required, but because of the linguistic demands of the task. Note however the two participants aged 4 years 9 months; Ellie, who has the higher BPVS score failed the task and Connie who has the lower BPVS score passed the task, highlighting the need for caution when interpreting these results.

8.1.3 Teddy search task – reading others' intentions

Participant	Age at testing in years months	BPVS average score	Pass fail search
Daisy	4.5	44	1
Freya	4.7	11	1
Theo	4.8	0	0
Connie	4.9	22	1
Ellie	4.9	28	1
Fabian	4.11	26	1
Maia	5.1	26	1
Joel	5.2	17	1
Ollie	5.11	32	1

Pass = 1 Fail = 0

Table 44. Group 2 Teddy search task passes and fails, organised by age of participant

Eight out of the 9 children in this group passed the teddy search task. Only 1 child needed prompts indicating that the task was pitched at an accessible level and the children were engaged with the activity. The children appeared able to pick up the non-verbal prompts and copy the researcher's activity to find the teddy without any difficulty. All children were on task and no off task behaviours were displayed. That the task had no verbal instruction may explain why those children who failed in Task 1 (the pretend play cats' task) were able to access this one. It's possible that the amount and complexity of information to be held in the working memory was less than in Task 1 and so the children were able to complete the task.

A discussion of this groups' performance versus group 1 performance (the 2 and 3 year olds in the study) on the same task can be found at Chapter 8.2 and suggests that age/maturation may be an indicator in performance in this task.

8.1.4 Symbolic play – the scarecrow task.

Participant	Age at testing in years months	BPVS average score	Pass/fail scarecrow
Daisy	4.5	44	1
Freya	4.7	11	1
Theo	4.8	0	Not attempted
Connie	4.9	22	0
Ellie	4.9	28	1
Fabian	4.11	26	1
Maia	5.1	26	1
Joel	5.2	17	1
Ollie	5.11	32	1

Pass = 1 Fail = 0

Table 45. Group 2 Scarecrow task passes and fails, organised by age of participant

Seven out of 8 children passed (passed 3 out of 4 episodes) of the symbolic play task and the task was not attempted with 1 participant, Theo. Of the children who passed Freya and Ellie needed prompts, and these same 2 children also failed one of the episodes. All the other children passed at ceiling, with no prompts and no failed episodes. Only Connie failed the task, however she displayed mostly on task behaviour, only losing focus on her last episode.

The high level of focus on this task may be down to task design; the task was play based and the relationship between the researcher and the child was reciprocal rather than instructional. The researcher asked questions of the child, but phrased in such a way that incorporated the question into the play: "I think the scarecrow is hungry, can you find an apple for him to eat?". Similarly the type of play may have been well practiced for many of the children; giving the scarecrow pretend food, putting a hat on him, putting him to bed.

That the children managed to transform the objects they chose, however, allows for speculation that they were going further than repeating well established play routines. The objects the children were given may have had some resemblance to the objects they were to be transformed into (a bowl becoming a hat for instance), however the children did not stick rigidly to a look–a-like; one child put a ball on the scarecrow's head for a hat. This suggests they were able to use a symbolic mental representation to transform one object into another and therefore it did not need to have a direct similarity. Indeed the object which posed the most difficulty for the children was a stick; when asked to help the scarecrow write many children picked the stick but were confused when it didn't work. Its resemblance to a pencil may have meant it was too similar to be symbolically transformed in play.

The high success rate in this task may also be explained by the simple language used. Sentences such as 'The scarecrow is tired, can you find him a bed?' were used to direct the play. Even if the sentence length was too long to hold in working memory, following only the second half of the question would allow for success in this task, provided you were able to symbolically transform objects.

8.1.5 Comparison across tasks – on and off task behaviours, passes and fails.

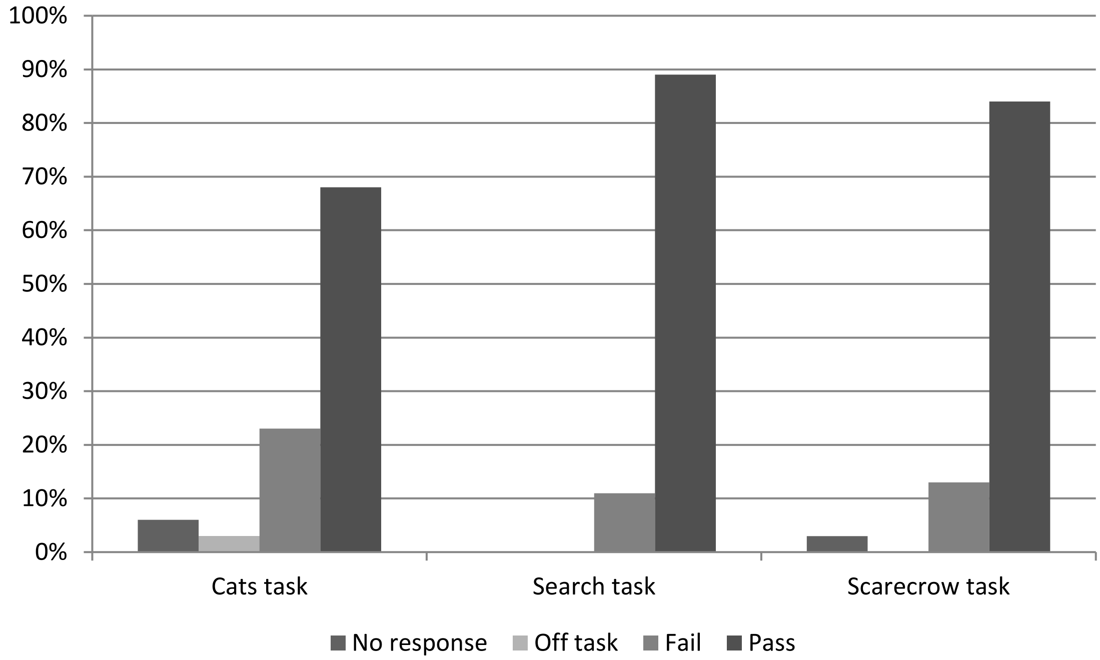

Figure 15. Group 2 No response, off task, fails and pass responses across all tasks

By far the most commonly seen behaviour in group 2 was a successful attempt at the task; most of the children passed most of the time. When discussing the rest of the results it must be kept in mind that the percentages of other behaviours seen are very small as can be seen in Figure 15.

Overall this group showed on task (passes and fails combined) behaviours 95% of the time. This level of on task behaviour could indicate they were engaged with the tasks and the tasks were pitched at a level where the children felt comfortable working. The nature of the tasks may also have helped with this; since the tasks were play based the children may not have felt pressure to provide an answer.

	Age in months	BPVS av. raw score	No response	Off task	Fail	Pass	On task (composite of pass and fail)
Theo	4.8	0	1	1	1	1	2
Freya	4.7	11	1		4	4	8
Joel	5.2	17			2	7	9
Connie	4.9	22	1		2	6	8
Fabian	4.11	26			1	8	9
Maia	5.1	26				9	9
Ellie	4.1	28			3	6	9
Ollie	5.11	32				9	9
Daisy	4.5	44				9	9
	Totals		**3**	**1**			**72**

Table 46. Group 2 No response, Off task, Pass and fails of individual participants across all 3 tasks, organised by BPVS average raw score

The three children who displayed 'no response', Theo, Freya and Connie, also have three of the lowest scores on the BPVS (see Table 46). This may indicate that there was some element of language comprehension difficultly in accessing the tasks for these three children, particularly since these 3 'no responses' are in the two tasks which require some language comprehension (Tasks 1 and 3). However, these very small percentages of 'no response' and 'off task' behaviours, must be seen in light of the more general on task responses (passes and fails combined) from this group.

Across all the tasks the children passed 82% of the time and failed 18% of the time. The pass rates appear to have some minor gains with improvement in BPVS raw score, as can be seen in Table 46, suggesting that the better the child's comprehension the more successful they were in passing the tasks. Conversely this suggests that failing a task may not be indicative that the child's ability to create mental representations is inhibiting success, but that it may be some difficulty with language which is preventing access to the tasks.

	Pass	Fail
Task 1 - Pretend play, Cats'	56%	44%
Task 2 - Other's intentions, Teddy search	89%	11%
Task 3 - Symbolic play, Scarecrow	78%	22%

Table 47. Group 2 Pass and fails rates, whole group, compared by task

When pass rates of the three tasks are compared in Table 47, it is clear that the more language based tasks (Tasks 1 and 3) have a larger fail rate than Task 2 which had no verbal instructions. The language difference may have some part to play in the increased pass rate of Task 2, but this may also be due to the fact that the task was originally designed for the youngest participants in the whole study, the 2 and 3 year olds in group 1. The task was added into group 2 when it became apparent that it was causing difficulties for the younger participants. A combined analysis of group 1 and group 2 responses to the Teddy search task is given in Chapter 8.2.

8.1.6 Use of prompts

Participant	Age in years months	Average BPVS raw score	Pass no prompts	Pass with Prompts	No response	Off task	Fail
Theo	4.8	0	1	0	1	1	1
Freya	4.7	11	3	1	0	1	4
Joel	5.2	17	6	1	0	0	2
Connie	4.9	22	3	3	1	0	2
Fabian	4.11	26	8	0	0	0	1

Maia	5.1	26	9	0	0	0	0
Ellie	4.9	28	4	2	0	0	3
Ollie	5.11	32	9	0	0	0	0
Daisy	4.5	44	9	0	0	0	0

Table 48. Group 2 Passes and fails by type of prompt used, organised by BPVS score

Written into the protocols for the sessions was the use of prompts to help the children attempt the tasks (see Chapter 6 and Appendix 2). When the tasks were scored the number of prompts needed to pass a task were marked. Two prompts were allowed before the task was deemed failed. A number of children in the sessions needed prompts to help them begin the task, however what was recorded was only the children who needed prompts and passed. In many of the failed and off task marks the researcher prompted the child, but this was not recorded in the data. An interesting further piece of analysis would be to examine all prompts and to see what proportion led to fails and passes. Table 48 shows the spread of each child's responses to individual episodes and brings up some interesting points.

Three participants Maia, Daisy and Ollie passed all the episodes with no prompts or fails, one of these being the youngest and one the oldest in the group. Four children in the group; Freya, Joel, Connie and Ellie, needed prompts to help them attempt and pass the tasks and all of these children failed at least 2 episodes across the session. The children who needed prompts show a much more even spread of types of response, indicating that they may be less secure in their understanding of the tasks and are using a number of strategies to either attempt or withdraw from the task.

Overall the prompts needed were evenly spread between the cats' task (3 prompts) and the scarecrow task (3 prompts), with only 1 prompt needed in the search task. All off the 3 children who needed prompts in the scarecrow task had either failed a episode or needed a prompt in the cats' task. The child who needed a prompt in the search task had also failed two episodes in the cats' task. This suggests that if a prompt was needed the children may have been insecure across all the tasks, but most often in the cats' and scarecrow tasks. As other data has also suggested the search task appears to have been the most accessible task for the participants in this group.

When compared against the children's BPVS scores 3 of the children with the lowest BPVS required prompts and all the children with scores over 26 did not require any, with the exception of 1 child. The children's need for prompts indicates that they may not be accessing the task as quickly as some of the other children and potentially need more processing time to work out the task requirements. Given that the researcher set the tasks through oral instruction supported by sign there may have also been a language processing element to the children's slow reaction to the tasks. That those who needed prompts also passed, failed and showed off task and no response behaviours indicates that they may be in a transitional period in the development of their pretend play abilities. All of the children who needed a prompt were able to pass the search task without prompts, indicating that they are at a developmental stage where they can understand another's intention; however their performance on the representational tasks were less secure. It could be suggested that the children in group 2 were developing their use of representations in play as they were all engaged in pretend and symbolic play at some point in the session, but these representations may be unstable.

8.2 Combined analysis of the teddy search task (groups 1 and 2)

The teddy search task was originally designed for the youngest participants in the study (group 1), but when the results from this group were initially analysed it became clear that the children in this group had found this a difficult task. The task was inserted into group 2’s assessments to address whether the task was at fault or whether the nature of the task was too difficult for the youngest children.

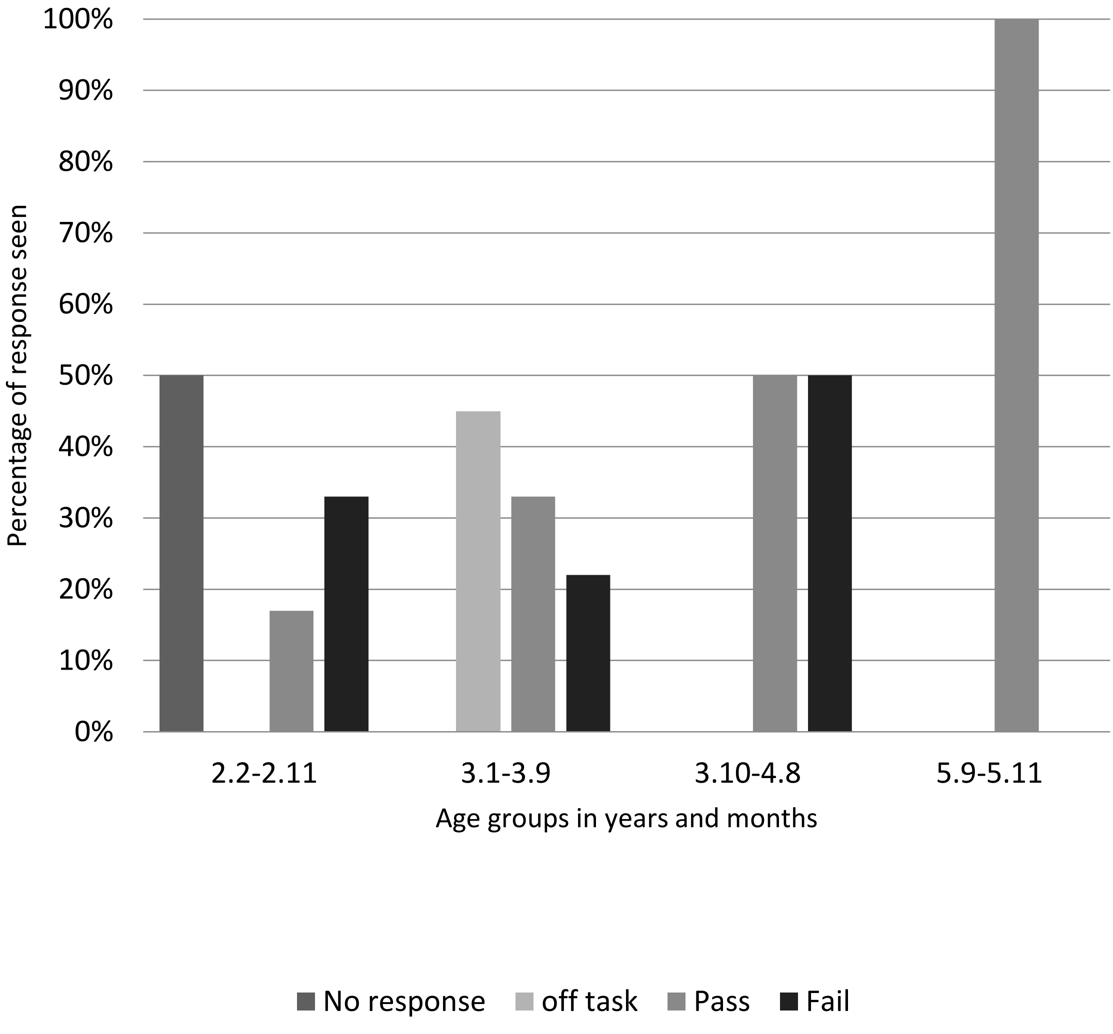

Figure 16. Group 1 and 2 combined results on the others’ intention teddy search task

The two groups results were combined to enable an analyis of children’s responses from age 2 to age 5. As can be seen from Figure 16 there is a marked improvement in pass rates from the youngest children at 17% to 100% for the oldest. Although this is an important finding in itsself as it shows that the task is accessible to the older children, what may be more interesting is the change from failing to passing. In order to address this the whole cohort of group 1 and group 2 were merged and split into four age groups spanning 10 months each. Age groups were chosen to represent an even spacing between the age of the groups. Table 49 shows the make-up of these groups.

Age span of group in years and months	Average age of group in years and months	N=
2.2 – 2.11	2.6	6
3.1 – 3.9	3.4	8
3.10 – 4.8	4.5	4
5.9 – 5.11	5.1	6

Table 49. Groups 1 & 2 Average ages and number of children after combining and dividing into 10 month age span groups

In the youngest age group of 2 years and 2 months – 2 years 11 months, the highest response is a ‘no response’ (see Figure 16), suggesting that the children were unaware that they could help the reseacher look for the teddy, or unaware that the researcher was even looking for something. In either case this would suggest that recognising another person’s intention was not something which was developed within their current cognitive profile. No child in this youngest age group showed off task behaviours, which suggests that the children in this group were either engaged in some way with the task or were unaware of the task set. The lack of off task behaviours in this youngest age group could suggest that they have not yet developed a sense of ‘knowing what they don’t know’.

As the children mature the nature of the way they approach the task changes; at 3 years the children begin show off task behaviours (see Figure 16 above). More children also begin to pass the task at this stage and less fail the task. This may suggest that as the children mature they become more aware of their own capabilities (or lack of them) and so are more likely to display off task behaviours as a way to reject a task which they are unsure of. There is also a possibility that the children in this age group are aware of a task but are unable to deploy the relevant skills to attempt it.

At age 3 years 10 months the pass rate increases along with the focus on the task, with 100% of children attempting the task in this age group (see Figure 16 above). At 5 years 9 months 100% of children pass the task. This change in the way the task is attempted suggests that it is not just an inability to complete the task which prevents children passing at a younger age. The youngest children appear to show a lack of awareness of the researcher's intention, indicating that they may not have the underlying schema or representaitonal ability to pass the task. The children aged 3 years appear to be aware of a task but may not be able to fully process it. It could be that, at this stage in development there is an incongruity of the child's cognitive ability and their processing capacities. In other words, the child understands the nature of the task, is able to see the researcher's intention, but is not able to hold this in mind long enough to carry out the task his or herself. In the teddy search task the child needs to be able to create a representation of the researcher's intention, hold in mind a representation of the teddy and carry out the action of searching. Combined, these mental and physical activities may be too demanding for a child of 3 years who has Down's syndrome. That the child is able to recognise and understand the task, but not carry it out may lead to the off task behaviours seen in the 3 years – 3 years 9 month age group. A potential developmental pattern may be that as the children's executive and memory functions improve they are first of all able to attempt the task (albeit with many still failing) and finally go on to pass the task.

8.3 Group 2 - Case series analysis

As with group 1 the qualitative analysis of group 2 was organised to examine a number of different areas; gesture and pointing, sign and speech, eye contact and focus, and body language and social interaction, as described in detail at the beginning of Chapter 7.

Children from group 2 were chosen for the case series in the first instance by whether they passed or failed the tasks. These groups of children were then split again, according to the flow chart in Appendix 7, to ensure an even spread of responses to the tasks. The four children chosen were selected to avoid an age bias in this part of the study. Group 2 is the smallest group in the study (N=9) and 8 of the children have only 9 months between their ages. To ensure an artificial age-ability increase was not created children of similar ages but who performed very differently were chosen. The children chosen for the case series analysis are all within 4 months age of each other and yet display remarkably different profiles of performance. Since children with Down's syndrome can sometimes be seen and treated as a homogenous group it was felt it important to explore the issue of different performances and profiles in similarly aged children (Tsao & Kindelberger, 2009).

Participant	Age at testing in years and months	BPVS average score	Seen at	Reason for inclusion in case series analysis
Daisy	4.5	44	Home	Passed all the tasks
Freya	4.7	11	School	Passed scarecrow and search tasks only
Connie	4.9	22	School	Passed Cats' and search tasks only
Theo	4.8	-	School	Did not pass any task

Table 50. Group 2 Attributes of the four children chosen for case series study

8.3.1 Eye contact and focus

Each child in the case series used their eye contact and focus in different ways, but often with a similar purpose. Generally the children did not look at the researcher often (Freya looking the most often) but 3 out of 4 looked to her when they either wanted to show her something, or needed her help. In each of the examples in Table 51 the participants use eye contact, rather than speech, to gain the researcher's focus and bring an object to her attention.

Daisy		
Social interaction	Focus and eye contact	Speech and speech sounds
Puts spoon in bowl but it slips inside, Tries again and same thing happens	Looks to R when the spoon slides in 2nd time, holds gaze until R notices	Daisy: oh…oh
	Gaze back on bowls even when R speaking	R: Oh its ok, there we are, oh it might just slide in, shall we put it by the side?
Puts spoon in bowl on RHS and it slips in. Shrugs shoulders		Daisy: teddy (?) …humph

Freya		
Social interaction	Focus and eye contact	Speech and speech sounds
Picks up milk bottle		R: Give them some milk?
Takes lid off, looks inside, holds up bottle upside down	Looks to R when holding bottle up	R: Which cat's having some milk? I know, it's just pretend

Connie		
Social interaction	Focus and eye contact	Speech and speech sounds
Shakes the packet, then tries to look inside. turns box around in hands	Focussed on box	R: That's it, it's just pretend, you can't open it. Everybody wants to open that box
Trying to open the packet	Looks to R as she tries to open the box. Glances at R's action of putting cereal in bowl	R: It's pretend Connie. Can you pretend, ch ch ch ch
Gives up trying to open packet and shakes it over the bowl on RHS, then moves to LHS	Glances at R again in middle of own shaking action (before R speaks)	R: Superb. Well done they both got some.

R makes cat on RHS eat out of bowl	Looks up at R and smiles as she makes cat eat	R: chumchumchcum

Table 51. Group 2 Examples of participants Daisy, Freya and Connie using eye contact to ask the researcher for help

In the examples in Table 51, Freya and Connie were both in need of some direction; they appeared confused that the milk bottle was empty/the cornflakes packet wouldn't open and so looked to the researcher for some help. Similarly Daisy requested the researcher's help with a spoon that wouldn't sit nicely on the side of the bowl, when the researcher didn't fix the situation satisfactorily Daisy shrugged her shoulders and 'humphed'.

That the children were able to use their gaze in such a way suggests that they have developed a capacity of shared attention and know that in order for another to attend to what you want you must first have their attention. That Daisy, Freya and Connie chose to do this primarily non-verbally (although in later tasks Daisy and Freya were more verbally active) suggests that they were aware of the theory 'to see is to know' and were using showing rather than telling as their primary means of communication.

For children who find clear articulation difficult this is potentially a more reliable route than speech, which can be misinterpreted. That the children did not know the researcher may have increased this insecurity as the researcher may have been more likely to misinterpret what the child was saying. There is some evidence to support this as later in the sessions both Daisy and Freya begin to use more verbal language to interact with the researcher, suggesting they may have felt more confident with the researcher at this point.

Theo did not engage the researcher in the same way; however he may have used looking to his mum in a similar fashion. In the example in Table 52 Theo appeared to look to his mum after he had thrown toys (twice) off his table. The researcher didn't react apart from to pick the toys up.

Theo		
Social interaction	Focus and eye contact	Speech and speech sounds
Picks up cups and throws on floor	Looks to where he has thrown cups	
Pushes cats off the table		R: I'll collect them, here they are
	Watches R, then turns away to look at mum	R: Can the cats, can my cats have a drink. Mum's there she's watching.
	Looks up to ceiling	Theo: unint R: Yeah she is
	Looks at R	R: Can we give them a drink

Table 52. Group 2 Example of Theo looking to Mum

Theo could have been making an intentional communication with his mum, which may have served one of two purposes. His look across to her could have meant 'I want to stop' (hence throwing the toys), or it could have been a look of 'I know I'm being cheeky throwing toys'. A similar situation happened twice more in the session. In each situation the eye contact appeared intentional; indicating that Theo, a child who does not yet speak or sign, has an understanding of the way eye contact and focus is used to communicate.

Throughout all the sessions, with all four of the participants, any shared focus was very much directed by the children. When involved in play they were mostly focussed on the activity and rarely made eye contact with the researcher, even when she was asking questions or giving instructions. During the exchange in Table 53 between Daisy and the researcher, Daisy does not look at the researcher at any point, even though they share a conversation.

Daisy		
Social interaction	Focus and eye contact	Speech and speech sounds
Picks up spoon, looks at it then puts it down	Focus on toys	Daisy: what…spoon…oh (unint)
Picks up stick and examines it. Looks at one end, tries to write, looks again then turns it around and 'writes'	Focussed on stick and paper	Daisy: colouring … oh… (unint)

	Focussed on stick and paper	R: That's good pretending. Well done. Can the scarecrow do some?
Hand the stick to the scarecrow (R is holding SC) and turns pages of paper	Looks to the scarecrow, then focusses on paper	Daisy: Yes…there you go…wanna drawing mine? (unint) pages. R: Want to turn the pages, ok that's fine.
R makes SC 'write ' on the paper using the stick	All the time focussed on the paper on floor	R: What do you think he might draw? Daisy: Daisy R: You think he's going to draw Daisy? Daisy: Yeah R: Is he going to write your name? Daisy: Yeah R: There we go. There! Good writing scarecrow!

Table 53. Group 2 Example of Daisy's interaction with the researcher

Although Daisy was very focussed on the toys and engaged with the play, she did not look to the researcher for clues about the play or for instructions. This could have been because her pretend play schema was secure and so she did not need to find any extra information in order to complete the play sequences. She may have been well rehearsed in pretending to give toys cups of tea and cleaning up and therefore completed those sequences from memory, whilst also being able to incorporate new information from the researcher.

That Daisy's language comprehension is unusually proficient (she is the youngest in the group, but scores the highest on the BPVS) may influence her ability to take in verbal instruction without having to make eye contact with the speaker. She appeared to understand all the instructions and requests the researcher gave and could answer without looking to the researcher. For Daisy the combination of well-rehearsed pretend play and proficient verbal and comprehension language skills may have enabled her to access and complete the tasks without looking to the researcher for extra information. Alternatively, the lack of looking to her play partner may come from a need to focus on the task in hand, in order to process the instructions, hold the pretence in mind and manipulate the pretence; she may have not had enough processing capacity to look at the researcher and take on pragmatic information as well.

In contrast Freya looked the most to the researcher during her session. She often looked when the researcher asked questions, when involved in play and to gauge the researcher's reaction. Freya used a variety of means of communication in the play situations as shown in Table 54. She was able to switch her focus between the researcher and the toys and appeared to complete actions according to the researcher's questions.

Freya				
Gesture	Use of sign	Social interaction	Focus	Speech and speech sounds
			Looking directly at R	R: I've got two cats
	cats		Looks to cats when signing. Follows them as R puts them on table	R: That's right, cats, nice signing. Here's one, here's the other one.
nods			Looks to R	R: Two cats!
nods			Looking at R but not at her face?	R: They're really thirsty. Shall we give them a cup of tea?
		Takes teapot from R, pours into RHS cup first then LHS cup then returns to both	Focussed on cups	R: Here's the tea pot, here's some tea cups. Oh good pouring
Nods in answer			Focussed on pouring tea – head down	R: Shall we give one cup to this cat? Shall we give it to them? Yeah?
		Holds cup in the air and then gives it to cat on LHS	Looks directly at R	R: Who's that cup for?...Who's it for? For this cat. That's good. Are they enjoying their cup of tea? shlp shlp shlp
Puts hand over mouth when R makes intake of breath	Copies R's sign cheeky		Looking at R and bird	R: Oawww, I've got a really cheeky bird
		Puts finger out to bird's mouth, R makes bird bite finger. Pulls finger away. Then presents it again.	Looking at bird	R: Its friendly but it's cheeky. quark quark quark. Freya: Ow! R: It's ok it didn't really hurt you!

			Watches the bird – glances to R	R: Look what this bird is doing. pssshhhh.
nods			Looking at bird	R: Ohh, he's put tea all over the table.

Table 54. Group 2 Example of Freya's eye contact with the researcher during a play sequence

Freya switched her focus to the researcher when the bird appeared, potentially looking to the researcher to gauge her reaction to the bird. Indeed she mimicked the researcher's initial intake of breath by placing her hand over her mouth and copied the researcher's sign for cheeky. When the bird performed the 'naughty' activity, pouring tea on the table, Freya glanced to the researcher, possibly to gather information about 'how we should react' to this naughty deed. Interestingly however, Freya fails this and all subsequent episodes in this task. Even though she seemed able to collect information from both practical and pragmatic aspects of communication and use the researcher as a guide, she was unable to follow the pretend play sequence once it departed from the norm. She was focussed on watching the bird 'spilling the tea', but when she was asked to clean it up she was not able to identify the correct area (she cleaned a cat instead of the table).

Since she is able to take part in the pretend play sequence, it could be suggested that Freya's representational ability is developed enough to create a pretend situation. However once the pretend play moved away from the practiced sequence, she seemed unable to hold all the information she needed in mind. As can be seen in Table 55, further on in the session Freya has incorporated the bird into her play script and anticipates its actions by handing it the toothpaste.

Freya		
Social interaction	Focus	Speech and speech sounds
Hands the bird the toothbrush, then the toothpaste	Watches bird and toothpaste going onto cats tail	R: Oh oh, here comes the naughty bird, she's going to take the toothpaste. ch ch ch ch

Table 55. Group 2 Example of Freya's anticipation of the bird in the pretend play sequence

Even with this re-writing of her play script however, Freya was unable to correctly identify the place where the toothpaste had gone (she cleaned the incorrect cat). A possible reason for this is that Freya lacks the underlying knowledge and relevant theories of physical properties. She cannot incorporate the knowledge of where the paste is as she does not have a secure enough theory about the property of liquids. Possibly her theory is that a liquid comes out of a vessel and goes 'everywhere' or 'anywhere', hence she cleans the centre of the table each time, not understanding that toothpaste would be limited to the place where it was squeezed.

Connie's eye contact is almost entirely limited to when she wants to draw the researcher's attention to her actions. In the sequence in Table 56 she appears to be looking for some kind of interaction, when she doesn't get the response she wants from the researcher she looks to the TA and then eventually turns her back on them both. Interestingly, although she doesn't do what the task requires (use a stick or spoon as a pretend pencil), she is able to symbolically transform an object (a stick) into something different (some food), and appears to want to share her ability to do this with the researcher and the TA.

Connie		
Social interaction	Focus	Speech and speech sounds
Reaches out and takes spoon. R puts pad and stick in front of her, she picks up stick as well. Then uses spoon to get some of stick and pretends to eat it	Looks up to R after pretending to eat – with smile	R: What can he use to do his writing? we need to pretend there is a pencil
	Looks and smiles at R, then looks around room	R: what can he use to do his writing Connie: unint
	Looks at TA	Connie: eh (unint)
	Looking at TA	TA: Cheeky. Do some writing Connie: eh (unint)
Plays with spoon and stick, holds spoon in air	With back to R	Connie: Spoon. R: It is a spoon, what a good word.

Table 56. Group 2 Example of Connie's eye contact with the researcher and the TA

Throughout most of her play Connie was focussed on the toys, not the researcher and only incorporated the researcher when she needed some help. Connie was able to pass the cats' task and the search task with very little looking towards the researcher. It could be suggested from this that Connie's representational ability allowed her to engage in pretend play. However, in a similar way to Daisy, it is possible that Connie may be able to hold in mind a number of representations, but to add in any more information (for example the researcher's facial expression or eye contact) may be too cognitively demanding.

Whilst Daisy's language profile was very proficient, Connie's spoken language was minimal (2 intelligible words) and her BPVS score was 22, in the lower range for the group. Yet they showed a similar looking pattern in the cats' task. It is important to note that although Connie's BPVS score was only 22, she was able to carry out most of the instructions asked of her even when she was not looking at the researcher when she was speaking.

The only looking behaviour which was consistent across three of the four participants was their ability to look to the researcher when they wanted her involvement in their communication. This happened at various points in the sessions and is illustrated in Table 57. Very often when the children were engaging with the researcher it was to add information to the topic or when they were off task.

Daisy (during BPVS)		
Sign	Focus	Speech and speech sounds
Doctor Gestures around neck – sign for stethoscope?	Looks directly to R when speaking and signing, both times	R: Binoculars Daisy: Doctor R: Oh that is like the doctor, yeah, this one. Daisy: Tethescope

Freya (during Scarecrow task)		
Body language	Focus	Speech and speech sounds
Lifts her left leg up and points to her shoe		Freya: My shoe
	Looking between R and shoe	R: My boy scarecrow Alex… Freya: My shoe R: What's up with your shoe? Freya: (unint) R:It's very nice
Lifts her other leg up and shows her shoe	Looking between shoes and R	Freya: (unint) R: And another one, you've got two
	Looking at SC	R: Are you looking at his shoes as well?
Lifts left leg again. then puts down and turns back to table	Looking between R and shoes and SC	R: Are they the same, he's got shoes on, different colour

Connie (during scarecrow task)		
Body language	Focus	Speech and speech sounds
	Looks back to bowl then to R as speaking	R: where can he go to sleep Connie? Connie: ness (unint)
Points into bowl		R: You're still eating your breakfast? Connie: sss R: Oh I see

Table 57. Group 2 Looking behaviours of 3 participants when engaging with the researcher on their chosen topic or when off task

All three participants in Table 57 are able to direct their focus to the researcher when they want to share information about what they are doing. Interestingly, these moments of shared interest for Daisy and Freya came just before a request to stop, and from Connie when she was disengaged with the scarecrow task. It could be that the children recognise that in order to control the situation, they need to have the researcher's attention and that attention is sought through eye contact as well as other forms of communication. These short episodes show that these 3 children are capable of maintaining joint attention when they feel it necessary.

Theo (during cats' task)		
Body language	Focus	Speech and speech sounds
	Turns and looks to mum then to where noise is coming from just below table	Bird squawks
On 'cereal' reaches out to birds beak	Very focussed on bird, watches and follows action. Maintains focus on bird throughout sequence	R: Here comes the bird. It's a cheeky bird. Look. Oh he's got the cereal, from the breakfast and he's going to make it go all over the table
Turns to cat to move it off table		R: (unint).
Puts fingers in birds beak, plays with beak	Completely focussed on bird whilst playing with it	Bird squawks a number of times R: Oh its noisy
Takes fingers away	Lifts head and looks up past R	

Table 58. Group 2 Example of Theo's prolonged focus on an object of interest

Although Theo rarely made eye contact with the researcher, the episode shown in Table 58 displays his ability to control his focus, firstly by looking towards mum and then a definite and prolonged focus on the bird (34 seconds). Whilst it appeared throughout the session that Theo's focus was not very well controlled, as he often looked up into the air and appeared to avoid eye contact, when he was engaged with a topic he was able to control his focus and maintain it for some time.

Considering Theo's ability to maintain focus in the example above, his apparent lack of focus throughout the session must be considered carefully. During this first session Theo was sat in his chair, with no ability to get out of it independently (during the second visit this was resolved and the researcher worked with him on the floor). As Theo's speech and signing was limited he had restricted means of communication available to him (one means, his ability to move away from the task, had been removed by seating him in a chair). Theo's 'lack of eye contact and focus' may have been his only means of communicating a lack of interest in the tasks or concern with lack of familiarity with the researcher.

Indeed in Theo's second session, where he was not restricted in his movement, he was able to engage and disengage with the tasks through physical interaction. A lack of eye contact, in Theo's case, may not have been a lack of focus, but a clear communicative sign that he was not interested in the tasks or the researcher.

From the analysis of eye contact and focus in Group 2 we can suggest a number of areas of interest which are consistent with the themes arising from Group 1:

a. *The ability to switch focus during a task, particularly during the instructional part, did not appear to make any improvement to task outcomes.*

   In fact Freya, who used most focus switching, failed the cats' task. The complex interplay of focus on the task and focus on the instructor (in this case the researcher) may be either not well developed or absent as a foundational skill.

b. *Children's use of checking that others had received their communication was limited.*

The children in group 2 appeared to use this knowledge only when it was helpful to their side of the communication (i.e. they sought eye contact when *they* were trying to move a topic on or add information, not when the researcher was). There may be a lack of awareness that eye contact is important for both the receiver and the sender of information.

8.3.2 Sign and speech

The children in this case series used very little sign and, with the exception of Daisy, very little speech throughout their sessions. This may have been as a result of lack of confidence in a new situation and an unfamiliar adult. Daisy was the most confident speaker and used this as her preferred method of communication, however she occasionally used sign to complement some of her speech. As can be seen in Table 59 Daisy used sign supported speech during the BPVS to move the researcher away from the target word (binoculars) to focus on what she wanted to talk about (the stethoscope).

Daisy (during BPVS)		
Sign	Focus	Speech and speech sounds
Doctor Gestures around neck – sign for stethoscope?	Looks directly to R when speaking and signing, both times	R: Binoculars Daisy: Doctor R: Oh that is like the doctor, yeah, this one. Daisy: Tethescope

Table 59. Group 2 Daisy using sign to support her speech

At this point in the BPVS Daisy had begun to choose incorrect answers so it could be suggested that she was beginning to find it difficult or had lost focus. It is possible that she found the researchers request to find ‘binoculars’ too difficult and focussed on a familiar picture instead. Daisy may have been searching for an unfamiliar word (stethoscope) and first came up with an association (doctor) which was easier to say and sign.

Freya also used sign to redirect the researcher when she was not engaged with the scarecrow task, as shown in Table 60. Throughout the scarecrow task Freya used a number of different strategies (which will be discussed further in the social interaction section) to redirect the researcher. Her use of sign to obtain the researcher's attention may come from her understanding of the praise she is given when she signs which is reinforced by the researcher when she signed 'A' for Alex. Freya was able to engage the researcher off task when she tried to sign 'which' and then turned this into the sign for aeroplane.

Freya			
Sign	Gesture	Focus	Speech and speech sounds
Signs A in response to R's sign			R: My scarecrow is called Alex, good signing well done.
Attempts to sign 'which' after R		Focus on own hands trying to sign	R: It could be a girl or a boy, which?
		Focus on own hands, trying to sign	R: Are you trying to sign which? Good girl what a good try. Freya, Freya
Allows R help her to create the sign for 'which'		Doesn't look at R	R: Do you want me to help you? Like this. Oh it's really hard. That's it. and stick the thumb out and the finger out and we say which
	Holds her hand up to show R which	Looks up at R	R: Good signing, which
Makes aeroplane sign with hand		Looking at R. Then gives a big smile on aeroplane	R: and it's a bit like an aeroplane as well isn't it, it's the same sign you're right. This is aeroplane isn't it?

Table 60. Group 2 Example of Freya using sign to distract the researcher from the task

Theo used no sign in his session and Connie's use of sign was limited to copying the researcher when she signed 'clean' and adding 'please' to a verbal request for help. Given that 3 of the 4 participants in the case series study used very little speech, it is surprising that they also used very little sign to communicate. In comparison to the group 1 case series, where 3 of the 4 children used sign to support their verbal and non-verbal communication, there appears to be less overall communication from the older children in group 2. This could be an expression of their understanding of the test situation and their wariness of the researcher or it may equally be a sample effect.

From this discussion of sign and speech there are 2 areas, following on from group 1, which continue to develop:

a. *Communication is not always recognised as a 2-way exchange.*

   Children in the group 2 case series used very little communication, suggesting that they may have not recognised their part in the joint communication.

b. *Communication is used to redirect the task or situation.*

   Two children from this group used communication to direct the researcher away from the task and onto a topic they wanted to communicate about.

Child	Sign	Copied	Independent	In task	To change topic	To add information	With vocalisation	With speech
Daisy	tired	✓		✓				✓
	drinking	✓		✓				✓
	hungry	✓		✓				✓
	eat		✓	✓				✓
	doctor		✓	✓				✓
	stethoscope		✓	✓				✓
Freya	cats’	✓		✓				
	cheeky	✓		✓				
	A	✓		✓				
	which	✓				✓		
	aeroplane		✓		✓			
	apple	✓		✓				✓
Theo	No signs used							
Connie	clean (3x)	✓		✓				
	thank you	✓		✓				
	please		✓			✓		

Table 61. Group 2 Signs used with and without speech during each case series participant’s session

8.3.3 Gesture and pointing

Although the children in this case series did use gesture and pointing it was relatively rare and much of their gesture use was culturally defined. Two of the 4 children showed a 'shock' reaction to the bird spilling the tea, and a third, Connie, gave the cat a cuddle when it had had 'milk' poured on it. These gestures, shown in Table 62, appear to be ritualised and are very similar to those seen in the group 1 case series.

Daisy (Cats' task)		
Gesture	Focus	Speech and speech sounds
	Watching R then looking at bird	R: Oh oh, here comes the cheeky bird again
Waves arms up in the air towards the bird – pulls a 'scared' face	Watching bird	
Freya (Cats' task)		
Gesture	Focus	Speech and speech sounds
Puts hand over mouth when R makes intake of breath	Looking at R and bird	R: oawww, I've got a really cheeky bird
Connie (Cats' task)		
Gesture	Focus	Speech and speech sounds
Helps R give the milk bottle to the bird	Focussed on bird pouring milk on cat	R: Yeah can he have the milk? What is he going to do this time? Oh cheeky bird.
Gives cat a cuddle	Focussed on the cat which has milk poured on its head	

Table 62. Group 2 Examples of culturally defined gestures used by three participants

Theo appeared not to use gestures or pointing during his session, however any gestures he may have used could have been hidden in his continuous movement and simply not picked up on by the researcher.

None of the children appeared to use gesture as an addition to or to enhance their speech and communication, with the exception of Daisy who used gesture once to reiterate her meaning. Similarly, the use of pointing (outside the BPVS) was limited; Daisy and Connie used pointing to show their answers to questions and Theo did not appear to use any pointing. However Freya's use of pointing was similar to that which was seen in the group 1 case series. In the example in Table 63, she pointed to direct the researcher away from the task she had not been able to complete. The researcher had prompted her 4 times to try and clean the tea up, but Freya had not been able to carry out the action. She handed the teaching assistant in the room the cloth as soon as she managed to redirect the task, which may imply she had achieved her desired result (to stop the task). In the second example Freya had just previously shown the stop card to the teaching assistant, but the teaching assistant had not reacted. Although she indicates at the end of this sequence that she is happy to continue, the pointing behaviours may have come as a result of the stop card not working as a way to stop the session/task. As the stop card was introduced as a novel way for the children to give ongoing consent, Freya may have been confused as to why it didn't stop the task and so relies on previously successful behaviours to finish tasks (redirecting the researcher).

Freya Pointing example 1, Cats' task			
Pointing	Social interaction	Focus	Speech and speech sounds
		Looks at R's hands as she's signing	R: Lets clean it up, shall I help?
		Looking to distance	Freya: (Unint) R: Wow that was a big sentence.
Points to something across room			R: Are you looking at the books? Yeah
Points again with opposite arm			
Points to cat on her LHS		Looks to R as she's speaking	R: These cats, they've finished their tea
	Turns to TA and holds out cloth		

Freya. Pointing example 2, Scarecrow task			
Pointing	Social interaction	Focus	Speech and speech sounds
			R: Do you want to stop? Or do you want to play some more
Points towards camera		Then looks at R	R: That's my video camera, it's looking at you and at me
Points to her LHS			
Points to her RHS near camera		Looking at R	R: Those are the books in the library
		Looking at R	R: Are you looking at the pictures on the wall
Points behind R		Looks behind R	R: Do you want to play some more?
		Looks to scarecrow. Nods slightly	R: yeah? Shall we play with my scarecrow

Table 63. Group 2 Examples of Freya using pointing to distract from the task

As she pointed to a number of different objects it appears that Freya's was not trying to direct the researcher's attention to anything in particular. In pointing behaviours of typically developing children if the message is not understood there is an attempt to repair the message by repeated pointing at the same object, or by accompanying pointing with speech sounds (Golinkoff, 1986). Freya did not make any attempt to repair her message when the researcher was unsure of what she was pointing at, in fact she pointed to a different place each time the researcher responded to her. This suggests that she was using the pointing simply to redirect the researcher, not to direct her to something of interest. This potential strategy could be of interest when examining the BPVS. If children with limited communication do not reliably point to direct their conversational partner, they may also not be reliably pointing to what they do or don't know in the BPVS.

Themes developing from group 1 and 2

a. *In this case series gesture use appears to be culturally defined rather than used as an addition to language.* Imitation of the researcher's gesture was also prevalent.

b. *Pointing appears to be used to distract the researcher.* However it is unclear whether the children are aware that ‘to see is to know’. Declarative pointing has been found to be less proficient in children with Down’s syndrome (Legerstee & Fisher, 2008) and the current analysis appears to be consistent with this finding.

8.3.4 Body language and social interaction

The analysis for this section is focussed on two areas: the children’s interactions when they attempting to redirect the task or avoid the task as these are the times when they interacted most with the researcher; and the lack of social interaction the children engaged in throughout their sessions. Whilst on task the children in this case series were very focussed on the toys and the task at hand, they rarely interacted with the researcher directly, but when off task the children’s interaction with the researcher appeared to increase.

8.3.5 Social interaction

As shown in the analysis of eye contact and focus above, all four of the children in this case series were able to follow instructions and play with the researcher without making sustained eye contact. In fact long periods of interaction would pass without the child’s focus shifting to the researcher, as is evident in Table 64.

Focus	Speech and speech sounds
Looks to boxes, then to bowls on ‘yeah’, looks to R on ‘cats’ then back to bowls	R: do you know after breakfast, Daisy: yeah R: those cats they need their teeth cleaning
	Daisy: yeah R; do you think you could clean their teeth? Daisy: yeah
Looking at toothpaste, not R	R: So this is just pretend ok?
Looking at toothpaste	R: it’s just pretend Daisy: lid on R: yeah we’ll keep the lid on, so we’ll just pretend to squeeze it ok?
	Daisy: squish squish squish…there

Focussed on toothbrush and cat	R: which cat are you going to do first? Daisy: cat
Glances towards cat on RHS	R: that's excellent brushing Daisy: cat
	Daisy: teeth R: lovely
Focussed on toys, doesn't look to R	Daisy: done
Looks to bird, not R	R: oh Daisy here comes the cheeky bird Daisy: ooh R: what's he gonna get? oooh
Watches the bird, then glances to R on 'tail' then watches bird again	R: he's squeezing toothpaste all over the cat's tail. oooh naughty bird. Oh dear
Watches the boxes, focussed on the sponge coming out of box	R: Daisy could you clean the cat
Glances at R	Daisy: yeah

Table 64. Group 2 Daisy's use of social interaction in the cats' task

Daisy was able to follow instructions and to observe and process the action she was involved in, but she did not use looking at the researcher as a socially useful tool in interpreting the task. It is possible that Daisy's language comprehension ability meant she was able to access the tasks by verbal instruction only but she needed to remain focussed on the task to enable her to process the instruction and work out the goal. It may be that in order to process all the task demands Daisy needed to filter out any information which she deems least useful in helping her to pass the task.

Interestingly, on the researcher's second visit, Daisy was very animated before and after the session and interacted with the researcher, showing her toys and telling her they were going on holiday. It is possible that Daisy identified a usefulness in using her social cognition skills in this situation that wasn't apparent to her in the cats' task.

Freya used a very different style of interaction and looked to the researcher often throughout the tasks. Although she did not use very much speech or sign she interacted with the researcher by looking to her and nodding in response to her questions and suggestions. For Freya however, her ability to interact with the researcher did not appear to help her with the more complex cats' task.

Gesture	Pointing	Interaction	Focus and eye contact	Speech and speech sounds
			Not clear where she is looking – either at R or cloth (or both as they are very close together)	R:can you clean where he poured the tea
		Takes cloth from R, slowly unfolds it		R: can you clean it up Freya: ah
Nods on tea everywhere		Turns to TA and holds cloth out. TA indicates to where tea was 'spilled' on table.	Looks to TA and then to table	R: oh it's a big cloth TA: oh you like cleaning don't you. Need you to clean that mess up. Oh dear, tea everywhere
Brings hand up to face and then onto forehead			Unclear focus – not on R or TA	Freya: eh. TA: urgh
			Peeps at R through hand	R: can you clean it? Let's clean it up.
		Makes large O shape with mouth	Looks up to R	
	Points to teacup			R: where's the tea?
	Point to other teacup	Sticks out tongue	After pointing looks to TA sat on her RHS.	R: well there is some in there that's right, and some in there that's right
nods			Looks at table	R: and some on the table, yeah? TA: oh
			Look sat R's hands as she's signing	R: lets clean it up, shall I help
			Looking to distance	Freya: (Unint) R: wow that was a big sentence.
Immediately after this episode Freya uses pointing as a way to distract the researcher from the task. (n.b. the teaching assistant (TA) had been asked to not be involved in the task)				

Table 65. Group 2 Freya's use of social interaction in the cats' task

As can be seen in Table 65, Freya was engaged with the researcher throughout the episode; she responded to her questions and made eye contact with her. However she also found the task difficult; when the researcher asked, “Where’s the tea”, she pointed to the tea cups, even though it was made explicit by the TA that the tea was ‘spilt’ on the table. She was unable to identify where the tea has been ‘spilt’ and displayed behaviours (hiding behind her hand) that possibly indicate she was feeling uncomfortable with not understanding the request to clean up.

Throughout her session Freya often looked to the researcher or the TA after answering a question or carrying out a request. This may have happened because she found it difficult to process the task and was looking for some reassurance about her answer (whether she is right or wrong). Alternatively she could have been looking for pragmatic signals from the researcher and the TA about the task, for example social signals from the adults as to whether her answer was appropriate. In contrast to the way Daisy behaves Freya appeared to need social reassurance about her performance, whereas Daisy appeared confident in her approach to the tasks and did not look for reassurance. This idea may also be supported by the change in Daisy’s looking in the harder stages of the BPVS, she regularly looked to the researcher and engaged her in her answering of the questions, as is shown in the discussion of sign and speech above.

Connie engaged in the tasks in a similar way to Daisy, she was able to access and pass the cats’ task without much social interaction. She mostly focussed on the toys in front of her, even when the researcher asked direct questions.

Body language and social interaction	Eye contact and focus	Speech and speech sounds
Puts toothbrush down and reaches for sponge before R speaks	Focussed entirely on the sponge	R: can you clean the cat with the toothpaste on his tail?
Uses sponge to clean correct tail	Focussed on sponge and then cat	
	Turns to TA and gives her the sponge, but doesn’t make eye contact	R: well done, good remembering, good girl

Immediately picks up milk bottle	Focussed on toys	R; do you think you could give them some milk?
Tries to take the lid off milk bottle	Focussed on bottle	Connie: milk R: ooh lovely talking Connie, milk

Table 66. Group 2 Connie's social interaction in the cats' task

The example in Table 66 comes from the third cleaning request in the task therefore Connie may have been expecting the researcher's question (indeed she reaches for the sponge before the request is made) and so was able to anticipate the sequence of spilling and cleaning.

This lack of social interaction in the tasks is evident in both Daisy and Connie's sessions even though they both appear to understand and perform the tasks effectively. However there is a marked difference in their speech ability and in their BPVS performance. Connie's BPVS score is one of the lowest in group 2 and she uses 3 intelligible words and signs throughout the session. Daisy scores the highest in the BPVS and is verbally competent for her age. It is possible then that language is not the mediating factor in participants' ability to pass the cats' task and that the level of representational ability needed has more influence over the children's passing or not passing. This is supported to some extent by the evidence of Freya, who has a better BPVS score and uses more language than Connie, but is unable to represent the spilt tea. It may be that the children who are using their representational ability to pass the task, Daisy and Connie, need to maintain focus on the task in order to update their representations with new information. As Freya is potentially not able to incorporate new information into her representation she is able to look to the researcher and the TA for extra social signals to help her work out the task.

8.3.6 Redirecting the task (off task behaviours)

All the children in the case series were adept at manipulating the tasks and the researcher to redirect the play when they chose. They used a number of strategies which ranged from approaches seen in typical early development, such as throwing toys away, to sophisticated engagement with the researcher to redirect her focus. The underlying driver of the redirections could be either because the child could not access the task or because they were bored or tired in the session. Redirection observed in the case series took three forms; refusing the task, self-directed play and engaging the researcher.

Refusing to engage with the task was used by 2 of the 4 participants, Theo and Connie. Neither of these participants used clear spoken language and only Connie used minimal signs (3 in the session). Connie showed her lack of interest in the task by physically moving away from the researcher and task:

When the BPVS is brought out Connie gets down off her chair and picks up her mat for sitting on and attempts to go out the door. She stays at the door until the R puts away the BPVS, brings out the scarecrow and asks if Connie will play with it. Connie then puts her mat down, comes back of her own accord and climbs back on her chair.

Table 67. Group 2, Connie's task redirection in the BPVS

As Theo was in his chair for his session, he was unable to move away from a task he was not engaged in. However he was able to show his lack of engagement in a number of other ways as seen in Table 68.

Throws cup on floor, focus follows where he has thrown the cup, then turns back to R. Tries to push cats off table, looks up to R, then to cats. *Looks up to ceiling.* *Takes cloth from R, looks to R and cats.* *Waves cloth around.* *Waves cloth down at LHS, drops on the floor.* *Glances at mum*

Table 68. Group 2 Theo's task redirection during the cats' task

Although both these children showed that they were not engaging with the task through a refusal to take part, there was a marked difference in the way they conveyed this information to the researcher. Connie recognised that one way to stop the task is to go back to class room, which shows some understanding of a wider context of the testing situation. Theo was unable to use this strategy because he was seated in his chair (we cannot say whether he would have chosen this strategy had he not been in in his chair) instead he removed the toys from in front of him. From his glances to the researcher and mum after he had thrown the toys it is possible to suggest that he had done this purposefully. However earlier in the session he also appeared to enjoy watching the toys as they fell.

For Connie and Theo their redirection behaviour may show signs of their developing metacognition, an understanding that 'I know that I don't know' which propelled them to reject the task. It could also be suggested that this behaviour is indicative of children who have not yet begun to understand other's points of view. Connie walking to the door to finish the session shows that she problem solved from a self-centred point of view; the way to stop the session is not by changing someone else's behaviour (i.e. the researchers) but by changing her own behaviour (removing herself from the situation). Similarly Theo solved the problem by removing the toys not by changing the researcher's behaviour (although one could argue that removing the toys necessarily changes the researcher's behaviour as she has to tidy them up). Connie also used the strategy of removing the activity in the BPVS; she pushed the board away and refused to continue.

Connie used a further strategy in the scarecrow task, which she found difficult to engage with:

Connie reaches out and takes spoon. R puts pad and stick in front of her. *Connie picks up stick. Then uses spoon to get some of stick and pretends to eat it. Looks up to R after pretend eating – with smile.* *Looks and smiles at R then looks around room.* *Looks at TA.* *Plays with spoon and stick.* *Holds spoon in air. Turns round and sits with back to R.*

Table 69. Group 2 Connie's task redirection behaviour in the scarecrow task

During this sequence Connie used the toys available to create her own pretend play. Her play was self-directed and did not follow the instructions of the researcher. She appeared to take pleasure in her own pretence as she smiled at the researcher and rejected the set task by turning her back.

This use of self-directed play is seen by 3 of the 4 children; they take the toys and use them in a different way than the task requires. It is possible that the children engage with the toys in this way because it means they will be successful in their play. If they are finding it difficult to engage with the task set by the researcher, and they are aware they are finding it difficult, an option with a more successful outcome may be to engage in their own self-directed play.

Table 70 shows that Freya used a number of different redirection strategies during the scarecrow task .

Looks to TA. Holds up stop card to TA – then puts it on table when no more reaction from TA. *Looks at R.* *Looking at R, points towards camera. Looking at R, points to her LHS. Looking behind R, points to her RHS near camera.* *Signs A in response to R's sign, looks to scarecrow.* *Attempts to sign 'which' after R, focussed on own hands trying to sign.* *Lets R help her to create the sign for 'which'.* *Makes aeroplane sign with hand. Looking at R. Then gives a big smile on aeroplane.* *Looking at scarecrow, makes scarecrow bite her LHS finger, makes scarecrow bite her RHS finger, switching focus between scarecrow and R.* *Lifts her left leg up and points to her shoe, looking between R and shoe.* *Lifts her other leg up and shows her shoe, looking between R and shoe.* *Points to the scarecrows shoe, lifts left leg again, looking between R and shoes and SC.* *Then puts down and turns her back to table.* *Picks up stop card and turns to TA, focussed on stop card. Holds up stop card to TA.*

Table 70. Group 2 Freya's use of off task behaviours in the scarecrow task

This wide variety of strategy use shows that Freya was attempting to problem solve using trial and error and was able to adjust her strategy in her attempts to prevent the researcher continuing. As each strategy didn't work and the researcher attempted to reconnect her with the task, she moved on to a different strategy. There appear to be four particular strategies she used in the example in Table 70:

a. Use of a new strategy: the stop card – a strategy which was introduced by the researcher at the start of the session.
b. Use of distraction: signing, pointing, showing shoes.
c. Use of self-directed play: making the scarecrow bite her fingers.
d. Rejection of task: turning her back on the table.

It is possible that Freya is using a repertoire of strategies which she has built up over the course of her development and as the most recently learned doesn't work for her (the use of the stop card) she tries out other strategies. That she was able to use the more complex strategy of engaging the researcher (by redirecting her with signing, pointing and talking about her shoes) shows that she had some understanding of other's intentions. To understand that to stop the session or task the researcher must be redirected from her goal (of continuing with the session) necessitates a reading of the researcher's intention (or desire) and means end thinking on how to manipulate it. Whilst this is not an indication of a fully formed theory of mind, it may show that some children in this group were able to use their understanding of intention to manipulate other's behaviour.

Daisy used similar strategies to Freya, but in an even more sophisticated way; she not only created some self-directed play, but involved the researcher in the play, as is seen in Table 71.

Looks at objects. R asks "what can we use as a hat?" *Picks up ball and puts it briefly on scarecrows head.* *Doesn't look at R – focussed on scarecrow.* *Shuffles backward to move into a position to play catch.* *Remains fixed on scarecrow.* *Throws ball to scarecrow who 'catches' it (with R's help) and then throws it back.* *Daisy throws ball back to SC but it bounces on R's head.*

Glances at R then back at ball then to R as she asks question "What can we use as a hat?" then back to ball. *Leans forward and places ball on scarecrow's head.*

Table 71. Group 2 Daisy's task redirection behaviours in the scarecrow task

In this sequence Daisy threw the ball to the scarecrow, which was being held by the researcher, therefore the researcher had to catch the ball on behalf of the scarecrow. Daisy redirected the play to something she was engaged with and that the researcher had to take part in, thereby directing the researcher away from her initial goal. Daisy also used the stop card twice throughout the session (both times in the BPVS), showing that she was able to take on a new strategy and implement it.

An interesting point of note is that many of the distraction techniques happened outside of the tasks (in between tasks) or after the child had already answered the researcher's question. In Table 71 above Daisy had briefly put the ball on the scarecrow's head in answer to the researcher's question and then began the distraction. It is possible that Daisy felt she had answered the question and therefore the session could move on in a way she would like it to. Similarly, in the example in Table 70 Freya began her distraction when the next task (the scarecrow) was brought to the table. These between task redirection behaviours could be why in the quantitative analysis there are very few 'off task' responses recorded. Even though the children in this group did display off task behaviours they were mostly not during in a task or were after they had provided an answer. This suggests that the children were aware of when a task was 'in progress' and were able to apply themselves to the task at that time.

Of note in the body language analysis of group 2 are 2 areas which are also reflected in the group 1 analysis:

a. In this case series the children had difficulty either initiating and maintaining joint attention or fully utilising the information gathered during joint attention.

b. *All the children in this case series disengaged from the tasks*. The children in group 2 used more sophisticated means to redirect the researcher and the task.

8.4 Group 2 - Interim discussion

In a similar way to group 1, the group 2 results show a uniformity of results when looking at the quantitative data, but the qualitative data shows contrasting behaviours across participants. By considering both aspects of analysis it may be possible to see a developmental pathway the children in this group are taking. Analysis from group 1 will be briefly referred to here but Chapter 10, the whole study analysis, will bring together analysis from all three groups. Figure 17 below gives an overview of the quantitative and qualitative observations made in this chapter and links them with other areas of research. Table 72 extends this overview to show how the data from group 2 connects explicitly to earlier discussions of working memory, executive functioning, prior knowledge and representational ability and provides a short description of how the social cognition and theory of mind skills may be developing in this group. Below there is an attempt to describe a tentative developmental pathway, expanding the overviews given in Figure 17 and Table 72 at the end of this chapter.

Some of the children in this group showed behaviours which could be considered to similar to those seen in with children just learning about object properties and object permanence (Piaget et al., 1969). Behaviours such as banging, mouthing and dropping toys were seen in conjunction with a ‘no response’ to the tasks set, which could suggest that the child is unable to access the task. In these children prior schemas may be limited to physical properties and pretend play sequences have not yet developed. It is suggested here that children at this level are restricted to a level I (implicit) level of representation (Karmiloff-Smith, 1995) which is based on their empirical understanding of objects (Rast & Meltzoff, 1995).

Children working at this level are able to represent objects which are directly observable, but they are not able to form representations of them which are shared across domains. Phonological loop difficulties may prevent the child at this level from being able to process and retain the verbal information in the tasks, especially in the more language heavy cats' and scarecrow tasks. However there is a need for caution here, as the child in group 2 whose behaviour matches this description most fully was also able to hold focus on toys which interested him and play with them appropriately (for example making the naughty bird 'eat' his fingers). In fact this child did engage in some limited play scripts on the researcher's second visit. That some purposeful focus and engagement with activity was observed suggests that the child was able to utilise an aspect of his social understanding. There were some play schemas in place, but the tasks set may not have activated them. This possibly suggests that a child showing these kind of behaviours may be affected by a poor inhibitory control response (Borella et al., 2013) which restricts their ability to control the throwing, banging and mouthing schemas which are present and prepotent (especially in the presence of new toys which haven't been explored before).

Although children at this point in their development may be lacking in representational ability, it may be as a result of poor working memory and inhibitory control responses which in turn restrict the exploration and development of new schemas. This idea is explored in cognitive load theory which suggests that if the cognitive load is too high, then learning cannot take place (Borella et al., 2013).

An increase in eye contact and a reliance on the researcher for feedback was apparent in children who showed mixed responses to the tasks (passing, failing, no response and off task). These children may have weak schemas which are in development. For example they may know about liquids, but not understand individual properties such as the difference in fluidly of a paste versus tea. In this instance children may check in often with the adults around them by looking to them and may be unfocussed in their activity due to a weak representation of the task. Representations, perhaps moving to level E1 (Karmiloff-Smith, 1995) or dual representation (Perner, 1991) cannot support pretend play because of weak underlying knowledge schemas. Whilst the representational ability may be in place, it may be constrained by weak knowledge schemas.

This potential mismatch of representational ability versus underlying knowledge could be an important feature in the development of theory of mind skills in children with Down's syndrome. This is supported by the findings of Beeghly and Cicchetti (1987) that children with Down's syndrome repeat their play actions for longer and engage more in concrete play than typically developing children. It could be that children with Down's syndrome need longer to secure their underlying knowledge schemas before being able to use these in a more abstract, representational manner. This need to focus on the concrete may also be seen in the children's inability to depart from an existing play schema and incorporate new information into it. For example children showing 'no response' to the cats' task may be finding the addition of unexpected material into their existing 'pretend tea drinking' schema too complex to process. This is supported by Carney et al. (2013) who suggest that concurrent processing and storage is a difficulty.

Children working this point in development may also be restrained by phonological loop difficulties (Jarrold, Baddeley, & Phillips, 1999) which could restrict their ability to follow instructions such as 'clean the cat's tail which has the toothpaste on it'. This may explain why some children were able to pass the more representationally complex scarecrow task but which had a simpler language component and not the cats' task, which was representationally more simple but the instruction was complex.

For children working at this level the use of distraction as a means to engage with the adults around them or to move off task shows the children's sense of other people is developing. They are able to use joint attention skills and declarative pointing to draw the adult's attention to their subject of focus. This growing understanding of others may be coupled with a developing sense of 'I know that I don't know' which leads the children to use a variety of techniques to distract the researcher and reject the task. This would be in line with what we know about typical children's developing metacognition; at around the age of 2 years they begin to use mental state terms to describe others and their own behaviour (Bartsch & Wellman, 1995; Wellman & Estes, 1987). At this stage they are developing an awareness of their own mental states and they are able to use simple reasoning in arguments and discussions (Dunn, 1988). What could be an important difference for the children in this study is that typically developing children at 2 years will have the spoken language skills to negotiate and explain behaviours (albeit in simple terms), but children with Down's syndrome often have spoken language skills which are delayed beyond their comprehension and more general cognitive abilities. So where a typical 2 year old could be expected to explain that they didn't understand, or that they don't know, the children in this study may not have the language skills to express this. Whilst they may have some metacognitive awareness of 'I know that I don't know', they are unable to express this in a verbal way and it is therefore expressed through the physical means of distraction and task rejection.

The children who passed and failed with prompts and then passed and failed with no prompts are more difficult to describe as the case series did not include any of these children. Without case series data behavioural outcomes cannot be discussed, however it may be possible to suggest how the children's underlying abilities support or constrain their attempts at the tasks. That these children showed no 'no response' or 'off task' behaviours during tasks shows that they were able to focus their attention within tasks. Potentially their representational ability has developed to a stage where they are able to represent things which are not there, supporting an ability to engage with the pretend and symbolic play tasks. This could be the beginnings of dual representations (Perner, 1991) where the children are able to use hypothetical information to problem solve (Rast & Meltzoff, 1995). Hypothetical representations would support schemas which use trial and error as a means to problem solve, which is why a combination of passing and failing across trials is seen. That the children at this stage are focussed on the task in hand may suggest a growing ability to control external distractions.

The final development observed in group 2 was to being able to pass all the tasks. This was accompanied with a clear focus on the task, such that looking to the researcher or other adults was minimal. This may suggest that the more focussed the children are on the task the more able they are to pass the task. This may indicate some children's developing ability to filter out information which is not essential for the task. In order to focus their cognitive resources on processing the task demands and on using their representational ability to call up and modify appropriate schemas they are able to reject information which is deemed not useful. Children appeared able to select information which was important for the task, such as the practical elements of the task and some pragmatic information, but reject the more obsolete or difficult to read elements of the situation, such as extraneous environmental or social cues.

Schemas for pretend and symbolic play appeared well rehearsed in these children and they were able to incorporate new information into their schemas, such as information from the researcher's unexpected play sequence. This would suggest that their representational ability is secure in being able to represent more than one representation at a time (Perner, 1991) and that representations can be shared across domains to incorporate new information (Karmiloff-Smith, 1995).

More developed inhibitory control mechanisms may allow for the control of *external* distractions (such as interference from the researcher, or environmental disturbances), but are still unable to inhibit *internal* distractions. This is seen in the children's inability to symbolically transform the stick into a pencil; their inhibitory control may be not strong enough to prevent the prepotent response that, because of its close look-a-like quality, the stick *actually is* a pencil. Even when the children were told it was really a stick, some still responded with an attempt to write and a phrase similar to 'it's not working'. This confusion over what something looks like, as opposed to what it really is, is supported in the appearance-reality distinction work of Flavell et al. (1986). Typically developing children between the ages of 3 and 5 develop in their ability to separate out what an object 'looks like' and what it 'really is'. The children in this study may still be experiencing a difficulty with this distinction which typically developing children have usually resolved by 5 years old (Flavell et al., 1986).

A further advancement that children who were able to pass the tasks made was their ability to request help and stop the tasks by engaging with the researcher. Although explicit, verbal requests for help were not made the children made good use of joint attention and non-verbal requesting to elicit the researcher's help with, for instance, opening the milk bottle. This suggests that, by this stage in their development they are secure in their understanding that other people are intentional agents who are able to be directed to align their focus with that of the child. Butterworth (1995a) suggests this happens in typically developing children at around 18 months to 2 years at which time pretend play skills also develop (Lewis & Boucher, 1997). The findings from group 2 suggest that the children in this study may have followed a similar pattern of development albeit to a different timescale and by overcoming a number of different constrains not seen in typical development.

8.4.1 Group 2 - Simple description of the development of theory of mind skills observed

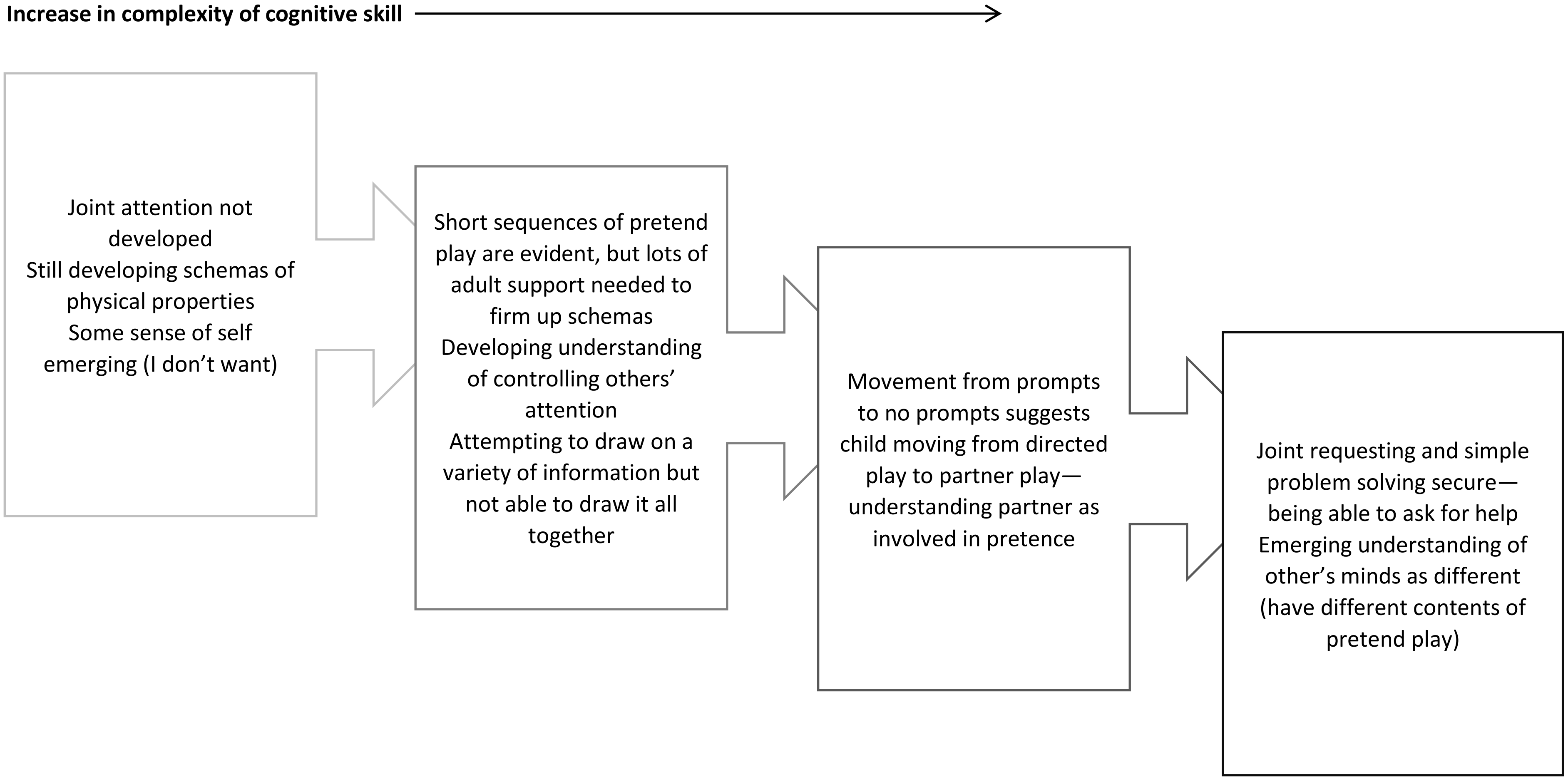

Figure 17. Group 2 Simple description of the development of theory of mind skills observed

8.4.2 Group 2 - Synthesis of qualitative and quantitative data and prior research

Increase in complexity of cognitive skill ↓	**Qualitative and quantative data linked to prior research →**					
	Description of qualitative behaviours observed	Description of quantitative findings	Prior knowledge and schemas	Representational ability	Working memory and executive function	Development of social cognition/theory of mind
	Doesn't make eye contact Rejects tasks by throwing/moving toys Purposeful communication when interested in the toy	No response to tasks Banging/throwing toys	Schemas in development for physical properties of objects No pretend play schemas	Level I (implicit) representation Empirical representations fixed to observable events and objects	Concurrent processing and storage not efficient Phonological loop difficulties preventing access to task Inhibitory control not controlling physical actions on toys	Joint attention not developed Developing schemas of physical properties Some sense of self (I don't want)
	Shifts focus between tasks, adults and environment Attempts to draw adults away from the task using a variety of means—distraction, engagement, refusal Checks with adults for encouragement/ praise	Mixed responses—pass, pass with prompts, fail, off task and no response	Underlying pretend play schemas are just developing but not consistently applied Short script sequences evident in pretend play	Hypothetical representations in development Representation not able to support longer play sequences—because of weak pretend play schemas.	Concurrent processing and storage made more difficult by weak pretend play schemas Phonological loop prevents clear representation of sequences	Short sequences of pretend play are evident, but lots of adult support needed to firm up schemas Developing understanding of controlling others' attention Attempts to draw on a variety of information but not

						able to draw it all together
	Not evidenced in case series	Fail and pass with prompts moving to fail and pass no prompts	Pretend play schemes are developing through trial and error	Able to represent entities which are not there	Inhibitory control developing enough to control distractions outside of task	Movement from prompts to no prompts suggests child moving from directed play to partner play—understanding partner as involved in pretence
	Focussed on tasks Able to request help verbally or through eye contact Uses sophisticated means to stop task—engagement with adult	Passes tasks	Pretend play schemas in place Others as intentional agents developing	Dual representation allows pretend play and allows for objects to be renamed in play	Inhibitory control is able to control external distractions, but not internal—the stick *is* a pencil	Joint requesting and simple problem solving secure—being able to ask for help Emerging understanding of other's minds as different (have different contents of pretend play)

Table 72. Group 2 Synthesis of qualitative and quantitative data and prior research

Chapter 9: Group 3 results and interim discussion

9.1 Group 3 – Quantitative analysis

9.1.2 British Picture Vocabulary Scales (BPVS)

The BPVS was administered in the same way as for group 2. Table 73 reports each participant's performance at T1 and T2 and shows the difference between the two time points, which were no more than 3 weeks apart. Six children got lower scores at T2 and 7 children got higher scores at T2. One child was unable to be tested, possibly due to difficulties with motor skills and 1 child's score remained the same. The average difference between testing points was -1 raw score points, however the range was from +22 to -31 and for some children the differences in their scores at T1 and T2 gave different results after converting to a comprehension age equivalent.

Table 74 shows the raw and standardised scores for all participants in group 3. Only Anna is able to score high enough to standardise her score at T2, but 6 children gain scores which are so different at T1 and T2 they result in different comprehension ages. Because of these marked differences in children's performance at the two testing points the average score from the two tests has been used throughout the analysis, as per the group 2 analysis. To create comparable results across groups 2 and 3 and because only 1 child was able to have their score standardised, participant's raw scores are used in this analysis.

	Age at testing years and months	T1 raw score	T2 raw score	Average raw score	Difference T1 – T2
Anna	6.0	39	55	47	+16
Misha	6.0	18	15	17	-3
Shana	6.0	13	13	13	0
Rose	6.5	26	28	27	+2
Morris	6.10	52	33	43	-19
Pria	6.11	41	43	42	+2
Alice	7.2	0	16	8	+16
Laura	7.6	37	44	41	+7
Jake	7.7	59	36	48	-23
Louis	7.11	U	U	U	-
Olivia	8.2	52	54	53	+2
Barney	8.5	69	63	66	-6
Scarlett	8.6	67	36	52	-31
Ruth	8.11	68	64	66	-4
Thomas	8.11	23	45	34	+22

Table 73. Group 3 BPVS - Differences in raw scores at T1 and T2, average raw score

	Age at testing years.months	Raw T1	St'd T1	Per T1	Age equiv T1	Raw T2	St'd T2	Per T2	Age equiv T2
Anna	6.0	39	***	***	<3.9	55	71	3	4.0
Misha	6.0	18	***	***	<3.9	15	***	***	<3.9
Shana	6.0	13	***	***	<3.9	13	***	***	<3.9
Rose	6.5	26	***	***	<3.9	28	***	***	<3.9
Morris	6.10	52	***	***	<3.9	33	***	***	<3.9
Pria	6.11	41	***	***	<3.9	43	***	***	<3.9
Alice	7.2	u	u	u	u	16	***	***	<3.9
Laura	7.6	37	***	***	<3.9	44	***	***	<3.9
Jake	7.7	59	***	***	4.5	36	***	***	<3.9
Louis	7.11	U	U	U	U	U	U	U	U
Olivia	8.2	52	***	***	<3.9	54	***	***	3.9
Barney	8.5	69	***	***	4.11	63	***	***	4.8
Scarlett	8.6	67	***	***	4.10	36	***	***	<3.9
Ruth	8.11	68	***	***	4.10	64	***	***	4.8
Thomas	8.11	23	***	***	<3.9	45	***	***	<3.9

Table 74. Group 3 BPVS - Raw scores (raw) standardised scores (st'd) percentile (per) and age equivalents (age equiv)

9.1.3 False-belief tasks. Episodes FB 1, 2, 3 & 4.

The fourth episode of the FB task (a repeat of the dolls episode) has not been considered in this analysis as it was not attempted with 5 participants and not completed with 2 participants, all 7 of these participants withdrew ongoing consent by either using the stop card or by refusing to engage with the task.

As can be seen in Table 75 the different method of presentation (dolls, book or tablet) of each episode did not lead to greater or lesser pass rates. Indeed the pass rate across the whole group and all episodes was very low. Sixty-seven percent of the participants (10 children) passed no episodes, 27% passed one episode (4 children) and only one child passed all three episodes. This participant is the only child in group 3 to 'pass' the false belief task.

Episode	No. of participants	Number of episodes passed in whole group
FB1 - dolls	15	2
FB2 - book	14	3
FB3 - tablet	15	2

Table 75. Group 3 False belief (FB) episodes. Number of episodes passed in whole group across all three tasks. N.B. One participant accounts for 3 of the passes

All of the four children who passed one or more episodes were older than 6 years 11 months, and three them were the oldest in group 3 (8.6, 8.11 and 8.11). Although age appears to have some relationship to passing an episode, BPVS score does not, as can be seen in Table 76.

Name	Age in years and months	FB episodes correct	BPVS Raw Score Average	BPVS age equivalent in years and months
Anna	6.0	0	47	<3.09
Misha	6.0	0	17	<3.09
Shana	6.0	0	13	<3.09
Rose	6.5	0	27	<3.09
Morris	6.10	0	43	<3.09
Pria	6.11	1	42	<3.09
Alice	7.2	0	8	<3.09
Laura	7.6	1	41	<3.09
Jake	7.7	0	48	<3.09
Louis	7.11	0	u	u
Olivia	8.2	0	53	<3.09
Barney	8.5	0	66	4.10
Scarlett	8.6	2	52	<3.09
Ruth	8.11	3	66	4.10
Thomas	8.11	1	34	<3.09

u = unable to administer the test. Shaded rows = participants who passed an episode of FB

Table 76. Group 3 BPVS - organised by age. Showing times passed a FB episode, BPVS raw score and BPVS age equivalent

Thomas, who is the oldest in the group, has one of the lowest BPVS scores and passed one episode of FB. Barney, who has the joint highest BPVS score did not pass an episode, although the two children with the next highest scores passed 3 and 2 episodes respectively. Although some increased likely hood of passing an episode with a higher BPVS score may be suggested, this is not consistent across the group.

As typically developing children begin to pass versions of the FB task between the ages of 4 and 5 (Wellman et al., 2001; Wellman & Liu, 2004) it could have been expected that the children who had a BPVS age equivalent score of over 4 years would begin to pass the FB episodes. However Barney, who has a verbal comprehension age of 4 years 10 months does not pass any episode, and yet Laura, Pria, Scarlet and Thomas, who all have a verbal comprehension ages below 3 years 9 months all pass at least one episode. This may suggest that the children in this group are not following the same developmental trajectory as typically developing children when acquiring their theory of mind, or that there is much more individual variation in when and how theory of mind develops in this group. It is also likely that, given the difficulty children with Down's syndrome have with acquiring spoken language, the connection between language and theory of mind is much more complex in this group than in the typically developing population.

9.1.4 Error pattern analysis

Within this section of analysis one child is omitted as he did not provide enough answers to be able to examine error patterns and 1 child is omitted due to researcher error preventing the correct recording of all his answers.

Because the limited pass rates of the false belief tasks had been anticipated, albeit in a less profound way, the way the children responded to the tasks was recorded in a number of different ways, as described in Appendix 2. Since the transition from failing to passing the tasks did not appear to follow a clear age related or vocabulary comprehension related pattern the *way* the children responded to the tasks was examined to highlight potential insight into how the children's theory of mind was or was not developing.

Any responses which were recorded as 'off task' were not included in the error pattern analysis; it was decided that if a child was displaying off task behaviour, this did not necessarily mean they did not know the answer, but they may have been finding it difficult to engage with the task (potentially for a variety of reasons). Off task behaviours are analysed separately in Chapter 9.1.7.

The different types of errors made are outlined in Table 77. The three most common types of error have been named according to the type of mistake been made. According to Flynn, O'Malley, and Wood (2004) a child without a fixed understanding of false belief will rely on reality to help them answer the questions, therefore pointing to the place where the toy actually is. Children who make this error response are unable to move away from the salience of the toy's actual hiding place and so point to the current whereabouts of the toy in answer to all three questions. This is named the 'salience' response and is shown as the Error-Correct-Error (ECE) pattern in Table 77.

The next most common error that was observed was a Correct-Correct-Error (CCE) pattern. Two correct answers are given in response to the questions which have some memory component ("Where did Dinah hide the toy?" and "Where is the toy now?"), however the child is unable to answer the false belief question correctly. This error pattern is termed the 'Memory' response and shown as Correct-Correct-Error (CCE) in Table 77.

The final most common response was Correct-Correct-Correct (CCC) in which all the questions are answered correctly and has been termed 'Correct' in this analysis. Although the Correct response is seen 23% of the time, one child accounts for 3 out of the 7 times this response is used (i.e. she always answered the questions correctly), so this must be considered throughout the analysis.

Other error patterns were seen, but were seen so infrequently that they have been termed 'indiscriminate' responses: an incorrect response to all three questions (Error-Error-Error), incorrect responses to the memory questions, but a correct response to the FB question (Error-Error-Correct), and two rarely seen responses: Correct-Error-Error and Error-Error-Correct.

Error pattern type	Q1: Where did Dinah hide the toy?	Q2: Where did Maxi hide the toy?	Q3: Where will Dinah look for the toy?	Recorded as	Times seen across all episodes	Percentage of times seen across all episodes
EEE	Error	Error	Error	Indiscriminate response	2	6%
EEC	Error	Error	Correct	Indiscriminate response	3	10%
CEE	Correct	Error	Error	Indiscriminate response	0	0%
ECC	Error	Correct	Correct	Indiscriminate response	1	3%
ECE	Error	Correct	Error	Salience response	11	32%
CCE	Correct	Correct	Error	Memory response	8	26%
CCC	Correct	Correct	Correct	Correct response	7	23%

Table 77. Group 3 Error patterns summary chart

Since the three most common error patterns were the Salience, Memory and Correct responses these errors are the focus of this analysis. The other error patterns combined make up only 19% of the responses and so it could be suggested that the children used them indiscriminately. It could be that the use of these indiscriminate error patterns is seen in children who do not have any developing understanding of false belief and therefore cannot understand the nature of the questions. Where the indiscriminate errors appear to change the dynamic of responses, they have been included in discussion.

9.1.5 Error patterns by task

	EEE	EEC	CEE	ECC	ECE Salience	CCE memory	CCC Correct
FB1 - dolls	1	1	0	1	3	4	2
	8%	8%		8%	25%	34%	17%
FB2 - book	0	2	0	1	4	1	3
		18%		9%	37%	9%	27%
FB3 - tablet	1	0	0	0	4	3	2
	10%				40%	30%	20%

Table 78. Group 3 Error patterns by false belief episode, given in raw numbers of responses and percentages

Table 78 shows that across the three FB episodes there is a similarity of responses. This suggests that the three types of tasks were of comparable difficulty and were tapping into the same cognitive functions. It is worth noting here that the participant who scores CCC across all three episodes is the only child who displays a consistent pattern of answers. All other participants show at least two types of error patterns. This could be considered in two different ways. It may be that the children are attempting some kind of trial and error process; since they are never given feedback on their answers this may be in the form of 'I don't know if I was right or wrong, so I'll try a different way.' What seems more likely, given the inconsistency in pointing and answering seen in the BPVS (as discussed in the case series analysis in Chapter 9.2) is that the children's responses are not always in answer to the question asked. Children often pointed to a place or grabbed for an object before the question was fully asked, indicating that they may have not heard the full question or that their reaction was not in response to the full question.

9.1.6 Error patterns by age

Error Response	EEE	EEC	ECC	CEE	ECE salience	CCE memory	CCC correct
Number of children	1	2	0	0	7	5	2
Percentage	6%	12%			41%	29%	12%

Table 79. Group 3 Error patterns made by children aged 6 years to 7 years 6 months

Error Response	EEE	EEC	ECC	CEE	ECE salience	CCE memory	CCC correct
Number of children	1	1	1	0	4	8	5
Percentage	5%	5%	5%		20%	40%	25%

Table 80. Group 3 Error patterns made by children aged 7 years 7 months to 9 years

When the group is split directly in to two age groups, 6 years to 7 years 6 months (Table 79) and 7 years 7 months to 9 years (Table 80), a clear change in the way error patterns are seen emerges. The children move from predominantly making the ECE (Salience) pattern to making the CCE (Memory) and CCC (Correct) answer patterns. In the younger group (Table 79) the predominance of ECE (Salience) suggests that the children do not have a sufficiently developed working memory to support them in the task and that their representational ability is restricted to the immediate present. The children only point at the present location of the toy and are not able to remember (or represent) where the toy was previously. This response also suggests they are unable to supress their prepotent response, possibly due to a less effective inhibitory function. Within this younger half of the group the three oldest children are responsible for all of the CCE (Memory) responses, which suggests there may be some change in children's responses with age. The older children appear able to employ their working memory to be able to answer the two memory questions correctly, however using metarepresentation to understand Dinah's belief is still too complex.

This picture continues to develop when the older half of Group 3 is examined (Table 80). A drop in the Salience response is seen alongside an increase in both the Memory and Correct responses, suggesting that the older the children have more developed working memories and can use metarepresentation to suggest Dinah's state of mind.

	Age in years and months	BPVS average raw score	Type of response most used
Shana	6.0	13	Salience
Misha	6.0	17	Salience
Anna	6.0	47	Salience
Rose	6.5	27	Salience
Morris	6.10	43	Salience
Olivia	8.2	53	Salience
Alice	7.1	8	Memory +1 other
Barney	8.5	66	Memory +1 other
Pria	6.11	42	Memory + correct
laura	7.6	41	Memory + correct
Scarlett	8.6	52	Salience, memory, correct
Thomas	8.11	34	Salience, memory, correct
Ruth	8.11	66	Correct

Table 81. Group 3 Error patterns organised by types of error most commonly made

To examine this possible pattern further the group was split by the types of responses the children used; what emerged was an even clearer age difference. As can be seen in Table 81 the whole group was split according to main type of error pattern the child made.

The youngest children, aged up to 6 years 10 months, all use the Salience response at least once, in fact it is the predominant answer used 67% of the time (Figure 18). None of this group passed any episode. The group of children aged between 6 years 11 months to 7 years 11 months use only the Memory response or Correct response (Figure 19). The oldest group, 8 years 2 months to 8 years 11 months, use a variety of responses and the Correct rate increased to 33% (Figure 20), bearing in mind three uses of CCC are from one child. The only child who does not 'fit' their age group is Olivia, who uses only the Salience and EEC responses, more similar to the youngest participants than her age matched peers.

As can be seen in Table 81, the individual BPVS raw scores show little relationship to the types of errors the children are making. For example Thomas who has a raw score of 34 makes the same error patterns as Scarlett who has a raw score of 52 and the children with the five highest BPVS scores make the whole range of error patterns. It could be that these children are trying out a range of strategies to approach the task. Because the relationship between BPVS score and strategy use appears complicated, other aspects of functioning, such as working memory, representational skill and prior knowledge may also need to be considered to explain the error pattern results.

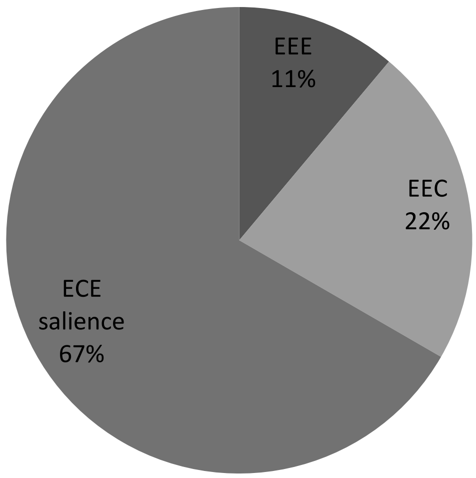

Figure 18. Group 3 Distribution of error patterns by children aged 6 -6.10 years in the FB task. N=5. Ave. BPVS raw score 29.3

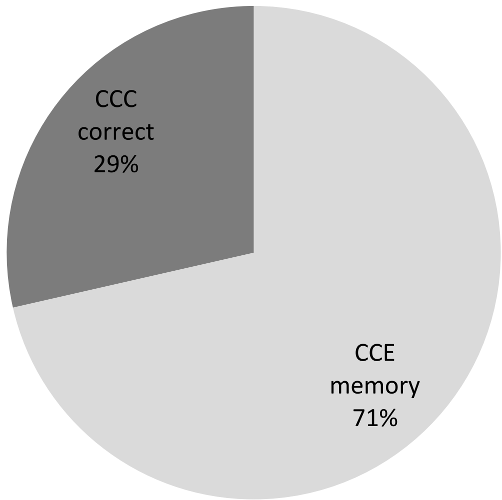

Figure 20. Group 3 Distribution of error patterns by children aged 6.11 -7.11 years in the FB task. N=5. Ave BPVS raw score 35

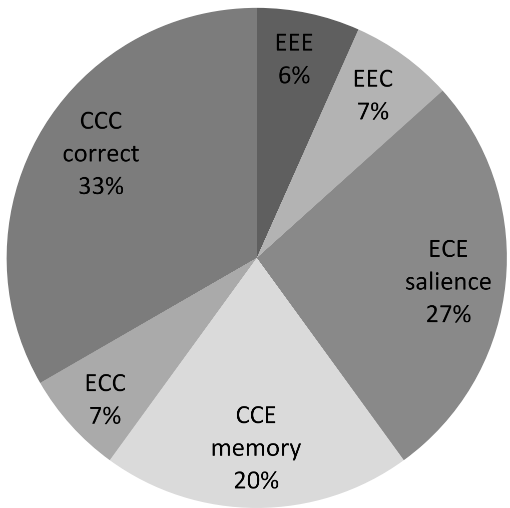

Figure 19. Group 3 Distribution of error patterns by children aged 8.02 - 8.11 years in the FB task. N=5. Ave. BPVS raw score 54

9.1.7 On and off task behaviours

Age in months	72- 90 (6-7.5 years)	91-107 (7.5-9 years)
	N=8	N=7
On task	70%	91%
Off task	23%	7%
No response	7%	2%

Table 82. Group 3 on and off task behaviours seen across all tasks, split by age (on task includes pass and fails)

Across all episodes the children were on task 79% of the time. This means they were engaged with attempting to answer the questions, even though they may have answered them incorrectly. The off task behaviours displayed tended to come from complete episodes; children usually displayed off task behaviours by refusing to engage with a whole episodes, as opposed to disengaging with individual questions. This suggests that the off task behaviours seen were more to do with the episode as a whole rather than a child's inability to answer a particular question. It does not appear that children were refusing to answer individual questions because they found them difficult, more so that they are not engaged with the episode in general. This may be because they were finding it difficult, or boring, to follow the false belief story and so 'switched off' before the questions were asked. This is explored further in the qualitative analysis of individual case studies.

As can be seen in Table 82 the number of off task behaviours is much larger in the younger half of the group. This suggests that this half of the group found it harder to access or process the tasks and resorted to more off task behaviours to avoid the tasks (for example both Misha and Rose put the dolls away in the box). The older half of the group were much more on task, even when they got the answers incorrect.

When the groups' off task behaviours are mapped against their average BPVS raw scores (Table 83), it appears that there may be some association between BPVS raw score and off task behaviour.

	Age in years and months	BPVS Average raw score	Number of off task behaviours recorded
Misha	6.0	u	5
Shana	6.0	8	6
Anna	6.0	13	3
Rose	6.5	17	6
Morris	6.1	27	0
Pria	6.11	34	4
Alice	7.1	41	1
Laura	7.6	42	1
Jake	7.7	43	0
Louis	7.11	47	0
Olivia	8.2	48	0
Barney	8.5	52	0
Scarlett	8.6	53	0
Thomas	8.11	66	0
Ruth	8.11	66	0

Table 83. Group 3 Children's BPVS scores and number of off task behaviours recorded, ordered by BPVS score

As the BPVS raw score increases, potentially indicating a greater receptive vocabulary, the number of off task behaviours decreases, indicating more engagement in the task. Whilst this improvement in receptive vocabulary does not necessarily allow the children to successfully answer the questions in the tasks, as evidenced in the error pattern analysis above, it may have allowed the child initial access to the task which enabled them to engage with the story.

Episode	FB1	FB2	FB3
On task	95%	63%	80%
Off task	5%	28%	15%
No response	0%	9%	5%

Table 84. Group 3 On and off task behaviours by FB episode

Only one child displayed off task behaviour in the FB1 dolls episode (Table 84); this high rate of engagement in the FB1 episode may be accounted for by the fact that it was always first and therefore the children were more likely to be responsive. In the FB2 book episode five children showed off task behaviours. These five have some of the lowest BPVS scores and four are in the younger half of the group. Two of these children went on to display off task behaviours in the final FB3 tablet episode, indicating that they were finding all episodes difficult to engage with.

9.1.8 Digit span task

The results of the digit span task were much as expected, no child in the group reached a digit span of over 3 and some were unable to access the task.

Name	Age in years and months	Digit span T1	Digit span T2	FB episodes correct	BPVS Raw Average
Anna	6.0	3	2	0	47
Misha	6.0	1	u	0	17
Shana	6.0	1	u	0	13
Rose	6.5	u	1	0	27
Morris	6.10	u	0	0	43
Pria	6.11	2	1	1	42
Alice	7.2	1	2	0	8
Laura	7.6	1	1	1	41
Jake	7.7	1	1	0	48
Louis	7.11	u	u	0	u
Olivia	8.2	1	1	0	53
Barney	8.5	1	1	0	66
Scarlett	8.6	1	1	2	52
Ruth	8.11	3	3	3	66
Thomas	8.11	1	1	1	34

u= unable to score

Table 85. Group 3 Digit span task T1 and T2

The only child who scored a digit span of 3 consistently was Ruth, who was also the child who passed all the false belief tasks and had one of the highest BPVS scores. However Anna also scored 2 and 3 on the digit span but did not pass a false belief episode.

The results of the digit span tasks were confounded by the way the children responded to the task. As outlined in Chapter 6 a Numicon number line was used to enable the children to respond physically to the task rather than orally. However, the way the children used pointing in response to the task was surprising. Most of the children were able to point to single numbers in an initial check of their number knowledge. When two numbers were introduced many children used both hands to point and kept each hand on each number. This meant they sometimes pointed to the two numbers simultaneously. When asked to point to three numbers the children found it difficult, because they only had 2 hands to use. Some tried to extend their fingers of one hand to point to the third number but would not lift their hand off the first or second number.

Whilst this doesn't help to give an accurate picture of the digit span of the group, it does illuminate some possible differences in the way children with Down's syndrome may approach tasks. That the children were not able to point to the numbers one after another and had to keep their hand on each number could suggest that the way they approached the task was to remember all the numbers together, rather than to remember a sequence of numbers. This is further supported by the fact the children often got the order of the numbers wrong. This could mean that the children are unable to discard numbers they have already used in the sequence and but retain the sequence as a whole.

9.1.9 False contents task

Because the false contents task came at the end of the testing session it was not administered to seven of the children and so the results of the task have not been used in this analysis. In designing the session it was felt that the False Belief episodes needed to take precedence in order to gain some results in this area and the false contents task could afford to be 'lost' due to withdrawn consent. That the children were fatigued and withdrew consent at this point in the testing session was not unexpected.

9.2 Group 3 - Qualitative analysis

Child	Age at testing in years/months	BPVS average score	Seen at	Reason for inclusion in case series analysis
Misha	6y 0m	17	School	Did not pass any FB tasks
Anna	6y 0m	47	School	Answered some reality/memory questions correct
Laura	7y 6m	41	Support group	Passed 1 FB episode
Ruth	8y 11m	66	School	Passed all FB tasks

Table 86. Group 3 Characteristics of the 4 children chosen for the case series study

Children were chosen for the case series by the same method as that used in the group 1 and 2 case series and by the criteria set out in the flow chart in Appendix 7. Again it was felt important to explore the issue of markedly different development in similarly aged children, so 2 participants aged 6 (Misha and Anna) were chosen for analysis. Some of the decision making for this case series study also had to be based on the quality of video; because of this none of the male participants were able to be included.

Qualitative analysis of group 3 follows the same rationale and sequence as that in group 1 and group 2.

9.2.1 Eye contact and focus

All four children were able to make eye contact with the researcher, but for some this was limited to particular moments or tasks. During the BPVS both Misha and Ruth looked to the researcher after they had pointed to each picture. It was possible that they did this either to gain feedback on whether they are correct or not (which is not given), or in anticipation of the next word. Laura did not look to the researcher at all throughout the BPVS and Anna often looked after the researcher had said a word, in order to have the word repeated. Misha also looked to the researcher during the BPVS after she had said or signed something, possibly to check that the researcher has understood or listened. The BPVS may have set up a strange situation for the children as they were being asked to complete a task without any feedback as to whether they were correct or incorrect and this may have impacted on how they interacted with the researcher later on in the session.

Misha - BPVS		
Pointing	Eye contact/Focus	Speech/speech sounds
Points first to leaf Then to carrot (says aya) Then to apple	Focussed on BPVS then looks to R when she says carrot. Watches R sign apple. Looks to BPVS to choose then back to R after choosing apple	R: apple Misha: aya (carrot) R: apple (signs) Misha:apple

Table 87. Group 3, Misha looking to researcher after speaking and pointing, BPVS

In the example in Table 87 Misha appears to check that the researcher has listened and understood her word and sign, indicating that she has some understanding that other people need to attend (either through listening or looking) in order to know. She checks that the researcher has listened to her speech (carrot) possibly with an expectation of response. However, throughout much of the session, Misha did not apply this principle to herself; she often did not attend (by looking) to the researcher when she was spoken to.

Misha – FB1		
Action	Eye contact/focus	Speech/speech sounds
	Looking up towards the camera – not focussed on R or her hands	R: Yeah? Ready? Where did Dinah hide her toy?
Seems to almost go for the drawers pauses at them, then grabs quickly at the box. R takes box from Misha	Looks down at box/drawers as they are moved	R: Which one, can you show me? That one ok.
Misha sits back, wriggles around, kicking feet under the table	Looking under table at feet.	R: Ok so when Dinah comes back in, here she comes…

Table 88. Group 3 Misha not looking at researcher when she is being spoken to, FB1

Although Misha could apply her theory of ‘to see/hear is to know’ to other people, and ensured that they were attending to her when she spoke and signed, she did not seem to recognise that she also must attend in order to know. Of course, Misha may have been listening attentively to the researcher whilst looking under the table, but she gives no social indication of her attention.

All four children, to varying degrees, ignore the social convention of looking at ones conversational partner whilst engaging with them, although there may be different reasons for each of them doing this. Misha, as above in Table 88, was often distracted throughout the session and her focus wandered regularly. Anna however, did look to the researcher when she was answering the key questions from the episodes but rarely throughout the episodes, even when speaking directly to the researcher.

Anna – FB3		
Action	Eye contact/focus	Speech and speech sounds
Gets Dinah and her toy	Doesn't look up at R on answering q, focussed on the car	R: Now what's she going to do with her toy? Anna: Hide it R: Hide it, good girl Anna: Wooo (playing with car)

Table 89. Group 3 Anna engaging with the researcher without making eye contact, FB3

In the example in Table 89 Anna appears to be listening to the researcher, as she answers her question, but the toys she is playing with take her visual focus. Laura's ability to engage with the researcher without looking at her was similar, she remained fixed on the toys for most of the session and answered questions without looking up. Ruth was able to answer all the 3 key questions correctly every time but she did not always look to the researcher when engaging in conversation with her, as can be seen in Table 90.

Ruth – FB3		
Action	Eye contact/focus	Speech/speech sounds
Picks up Maxi doll, makes him get car out of bag, takes car to drawers and puts in blue drawer.	Focussed on the Maxi doll	Ruth: Get the car R: He's going to get the car. That's it. What's he going to do with the car? Ruth: He put it in there.
Drawer falls out, she puts it back in.	Focussed on own actions with dolls	Ruth: I can't do it

Table 90. Group 3 Ruth engaging with the researcher without making eye contact, FB3

It may be that for these four children to focus on the story line and the action in front of them is a more efficient use of their cognitive functions, such as working memory, than switching their gaze between the researcher and the activity. Ruth's looking pattern in FB1 as seen in Table 91 where she was observing the action and not being involved in the story line, is markedly different than the example in Table 90 when she was physically engaged with the action.

Ruth – FB1	
Eye contact/focus	Speech/Speech sounds
Watching R's hands and face	R: I have got a girl here, this girl is called Dinah,
Watching R's hands and face	R: and the boy is called Maxi
Looks at dolls	
Looking between R and dolls, points accurately	R: Can you point to Dinah, that's right, and can you point to Maxi, well done.
Looks at Dinah when R says name. Then looks at toy in R's hand	R: Dinah has got a very special toy. Can you see? That's Dinah's toy.
Watches R put the toy near Dinah, looks at Dinah	R: She really loves it, it's very special.
Looking at the dolls, not the R. Glances at R, watches action	R: She wants to hide it away so she's going to put it in her drawer.
Looks at R after she has put the toy in the drawer	R: Shall we put it in?

Table 91. Group 3 Example of Ruth's looking pattern, FB1

As FB1 is the first time the children hear and see the FB story, it could be that in the example in Table 91 Ruth was gathering information from a variety of sources in order to help her comprehend the story. When the children were on their third repetition of the story (FB3) they all appeared to have learnt some aspects of the story (the dolls names, the sequence of the action, for example) and were happy to be involved in telling the story. Potentially the more interactive storytelling in FB3 needed them to focus on their own actions and draw on their own internal resources to remember and act out the story, rather than look to the researcher for guidance.

Despite the children's lack of eye contact *during* the episodes, all four children make use of gaze switching between the researcher, her hands (as she is signing) and the toys when the researcher asks the 3 key questions at the end of the episode.

Misha – FB1		
Action	Focus and eye contact	Speech and speech sounds
	glances at R, then at own hair (playing/chewing) then at Dinah, big smile	R:Dinah's coming back in now
glances at box on Maxi, goes immediately for box before q is finished.	looking at R and her hands signing.	R: I've got some questions. Misha, where did Maxi hide the toy?
	glances at R – with big smile	R: Good girl
goes straight for the box, R intercepts	watching the signing, glances at R	R: Where did Dinah hide the toy?
R taps Dinah's head, Misha copies.	looking at dolls	R: Where did Dinah hide the toy. Misha: phhhhh
	looks at R, then down	R: Can you remember? Shall I ask again? Misha: (nods)
Anna – FB1		
Goes to take box, R moves it back When box is moved back Anna goes to take drawers	focussed on r, then box	R: Where did Dinah put her toy?
	focussed on drawers then looking at Dinah	R: Just wait. Can you point to where Dinah put her toy?
	looks at R after pointing	R: Can you point to where Maxi put the toy? Aww
	looking at R then at Dinah doll	R: Point to where you think Dinah is going to look for her toy. Anna: di (unint)
Takes doll from R and makes Dinah 'look' in the drawer	focussed on Dinah and then drawers	R: Where is she going to look for her toy? Anna: There
Laura – FB1		
	glances up to R's face (before she says her name), then watches her hands	R: Laura, where did Maxi hide the toy?
	looking at the box	Laura: The box R: good talking

reaches towards the box, picks it up and opens it	watches R's hands signing then looks at drawers	R: Where did Dinah hide the toy? Good looking.
R takes box and puts lid back on and places back on the table	focussed on box	R: Well done, so, oh waiting, put the lid back on, Laura: unint R: just put it back on that's it.
	looks to Dinah, follows R's hands	R: So when Dinah comes back in and she wants to look for her toy where is Dinah going to look
	looks at box	Laura: there
Ruth – FB1		
	Glances at R, watches her hands, looks to Maxi, watches the action Looks at R	R: Maxi really wants Dinah's toy, so he is going to get it out of the drawer and he is going to hide it in his box
	Looks at R whilst she is asking the question	R: Can you remember, where did Dinah put the toy?
	Looks at drawers	Ruth: In there R: That's right
	Looks at R as she asks the q	R: and where did Maxi put the toy?
	Looks at box	Ruth: In there
	Looks at R, glances at the drawers whilst q is being asked, then back to R	R: So when Dinah comes back in where is she going to look for the toy?
	Looks at drawers and then R whilst pointing	

Table 92.Group 3 Misha, Laura, Anna and Ruth's gaze switching when the researcher is asking key questions

Even though all four children are able to switch their focus during the final questions, this does not appear to have any relation to whether they are able to pass the task or not. This may suggest that it is not lack of attention to the questions which is causing the children to fail the task. Whilst there is evidence of children losing focus (Misha in Table 88 above, for example) this appears to be at least after the first question is asked. This indicates that there may be a comprehension difficulty rather than a lack of focus preventing access to the questions. Whilst they may attend to the final questions, they may not understand the concepts underlying them, which leads to incorrect answers.

An understanding of the FB storyline however, may be observable through the children's looking patterns as seen in Table 93. All four children looked towards the researcher when she suggested that Maxi was going to take Dinah's toy. This could be some indication that they are aware of the social and moral aspects of the story and that they are able to attribute some sense of ownership to the dolls (this is explored in more depth in the discussion section).

Misha – FB1		
Action	Eye contact/ focus	Speech/ speech sounds
very quick glance at drawers then back to Maxi		R: But look who's come. Maxi.
	looks at R then at floor then back to R	R: He wants Dinah's toy.
	looks at drawers	
takes toy out of drawer, gives it to Maxi		R: He's going to go and get it. That's it. Ohhh Maxi.
Anna – FB1		
R tries to take maxi, but Anna holds on to him	focussed on Maxi	R: Maxi really wants Dinah's toy, he really want to play with it
	looks to R	
helps to take toy out of drawer and hide in the box	focussed on the toys – watching the action –	R: He's going to take it out of the drawer and he's going to hide it in his box Anna: laughs
Laura – FB1		
	looking at Maxi doll	R: well, Maxi is quite cheeky
	watching Rs hands, looks to her face when she signs hide	R: He's going to take her toy, and he's going to hide it somewhere else
	watching the action	R: maxi's going to take Dinah's toy, he's going to play with it, and he's going to hide… Laura: whispers unint R: …it in his box
Ruth – FB1		

	glances at R, watches her hands, looks to Maxi, watches the action looks at R	R: Maxi really wants Dinah's toy, so he is going to get it out of the drawer and he is going to hide it in his box

Table 93. Group 3 Misha, Laura, Anna and Ruth looking to the researcher when she suggests that Maxi is going to take Dinah's toy

That the children looked to the researcher at this point is not indication in itself that they understood the nature of the story, however their looking at the crucial point when Dinah came back in to find her toy, may provide further evidence of their understanding of the story.

Anna – FB1		
Action	Eye contact/ focus	Speech/ speech sounds
	focussed on the Maxi doll but glances at R	R: Let's put Maxi over here, I just want to pop him over here. Dinah is going to come back now.
takes chest of drawers and moves then towards her, then allows R to push them back	looking at drawers then focussed on Dinah	R: ok
Laura – FB1		
smiles at Dinah and Maxi dolls	looks towards Dinah's drawers, then looks towards Dinah	R: Dinah is going to come back inside, here she is, she's coming back. Oh hello, hello Maxi

Table 94. Group 3 Anna and Laura looking to where Dinah hid her toy on Dinah's return

As seen in Table 94, Anna and Laura looked towards the place where Dinah hid her toy (not the place where the toy currently is). Laura passed one episode and Anna was able to correctly say where Dinah will look, but got the memory questions wrong on two episodes. This supports the suggestion developed in the discussion section below that some of the participants may be developing their theory of false belief, but are struggling with conflicting theories.

Ruth – FB1	
Eye contact/ focus	Speech/ speech sounds
looks at R, glances at the drawers whilst q is being asked, then back to R	R: so when Dinah comes back in where is she going to look for the toy?
looks at drawers and then R whilst pointing	

Table 95. Group 3 Ruth looking at her answer before the researcher has finished asking the FB question

In the example in Table 95 Ruth, who passes all the FB episodes, did not look to Dinah's initial hiding place when Dinah was reintroduced to the story, possibly because her false belief theory is secure enough and she is not experiencing any conflict of theories. Ruth glances at her answer whilst the researcher is asking the final question, further indicating that there is no conflict for her, she is sure of her answers.

The children's eye contact and focus indicates a number of areas worthy of exploration throughout the rest of the case series analysis of group 3, and follow on from group 1 and group 2 analysis:

a. Varying patterns of looking at the researcher are not necessarily indicative of the level of attention being paid to the task.

This group did not show any consistent patterns in their looking behaviours; switching between the researcher and the task did not necessarily mean a better understanding of the story or its underlying principles. This is consistent with evidence from group 2 where gaze switching was also unrelated to passing or not passing tasks, but contrary to group 1 whose participants' were more successful when they were able to gaze switch.

b. Participants looking may indicate a moral/social understanding of the story.

That the children looked to the researcher when Maxi was about to be 'naughty' may indicate that they understood the story on a moral or social level, and therefore were able to attribute some 'character' to the dolls.

c. Children's looking may indicate emerging knowledge.

That 2 of the participants were able to look Dinah's correct hiding place when she returned to the story, even though they were incorrect in their answers, could show that they are struggling with conflicting theories.

d. Children's use of checking that others had received their communication was limited.

That the children used looking to the researcher at points where they were being asked a question and when there was some sense of moral injustice, may indicate a developing sense of their understanding that ‘to see/hear is to know’, however this is not consistently applied. ‘To see/hear is to know’ may be a late developing skill, and one which underpins the FB task. The data from all of our groups suggests that the theory of ‘to see/hear is to know’ is difficult for this group of children to build. Although able to switch gaze when the researcher was asking questions, all the children in this case series showed some evidence that this theory was not secure; they often did not look at the researcher whilst engaging with her. It could be that the children were able to apply the theory to themselves but have not yet applied this theory to others. This may mean they are also unable to apply the theory to Dinah and so are unaware that if she is ‘not there’ she cannot see what is happening to her toy.

9.2.2 Speech and signing

Consistent with the group 2 findings, the children in group 3 used very little sign and very little unsolicited speech. As suggested in group 2, by this age the participants may have been aware and wary of the unusual test situation and of an unfamiliar adult. Indeed many of the participants were more vocal and communicative in their second sessions. All of the participants’ in this case series study were able to respond verbally to the task, however this is not representative of the whole of group 3. Two of the children were not verbally proficient enough to use speech, but were able to respond through physical means and through vocalisations.

Very few children in the whole of group 3 used sign and only Misha in this case series study produced any number of signs (5 altogether). Misha is the youngest in the whole group 3 cohort (she had just turned 6 when she was visited) and showed a low BPVS average score. Her signing was used in support of her speech (rather than instead of), but it was very sparse across the session. That such little signing was used in group 3 was a surprise to the researcher, however all the children in this case series study appeared interested in and focussed on the researcher's use of sign. Much of their gaze moved between the researcher's hands and the toys as is evident in Table 96.

Misha –FB1	
Eye contact/focus	Speech/speech sounds
Looking at R and her hands signing. Glances at box on Maxi	R: I've got some questions. Misha, where did Maxi hide the toy?
Anna - FB1	
Looking at the doll	R: this girl, she's a girl and she is called Dinah Anna: eee R: Dinah
looking at the dolls, then watches R's hands then looks to her	Anna: cavah (Dinah) R: this boy, the boy is called Maxi
Laura – FB2	
looking at appropriate picture, watches R as she signs	R: he's hiding it here, and what colour's his cupboard? Laura: green R: lovely talking yeah he's put it in the green cupboard
Ruth – FB1	
watching R's hands and face	R: I have got a girl here, this girl is called Dinah
watching R's hands and face	R: and the boy is called Maxi

Table 96. Group 3 Misha, Anna, Laura and Ruth watching researcher's hands as she signed

Whilst it is impossible to suggest what impact the researcher's signing had on the outcome of the tasks, it is notable that all 4 of the case series study children paid attention to her signing.

A particular use of speech from this group was designed to move the researcher away from the task and onto a topic more appealing to the child. This happened most commonly during the BPVS.

Misha - BPVS			
Pointing	Body language	Eye contact/focus	Speech/speech sounds
points at picture of a bag	head down, rubbing eyes	looks to R after pointing, then looks at table	Misha: Ba R: There is a bag, listen
points at belt and moves finger round			Misha: round
points at zip (almost without looking)	rubbing head, moves head down towards the table	looking vaguely at BPVS, then at table	R: Listen, belt
points very quickly to incorrect picture without looking at BPVS		looks up to R	R: Look at me Misha, belt good girl

Table 97. Group 3 Misha using speech to redirect the researcher and draw attention to her chosen topic, BPVS

In the example in Table 97 Misha had become distracted during the BPVS and may have been finding the words at this stage a bit difficult. Rather than giving up however, she chooses to engage the researcher in discussion of her own chosen words, instead of the more difficult ones chosen by the researcher. Anna used a similar tactic when she attempted to engage the researcher in discussion about a picture which interested her (although note, she doesn't make eye contact with the researcher throughout the exchange in Table 98).

Anna - BPVS		
Action	Eye contact/focus	Speech/speech sounds
points to a picture	focussed on BPVS	Anna: What those R: Hopping *(not in response to Anna's question)* good girl
helps turn page	focussed on BPVS – doesn't look at R during exchange	Anna: Look, look R: Oh, what's she doing? Anna: Climbing R: That's right she is on the climbing frame Anna: Me too

Table 98. Group 3 Anna changing the topic to talk about a picture which interests her, BPVS

Laura and Ruth displayed no off task speech and most of their speech was in response to questions.

Because most of the speech from the case study series participants was in response to questions, their responses were very short and limited to one or two word answers. However, as seen in Table 99, all four children increased their speech in the FB3 episode.

Participant	FB1	FB3
Misha BPVS score 17 Age 6 y	Maxi oh bye phhhh where	unintelligible oh oh baby hide toy bye blue out no there no der, der
Anna BPVS score 47 Age 6 y	eee Cara (Dinah) you have Maxi there x2 in there	yeah back again what's that? sit her down hide it swimming Maxi in there coming back he's sitting down x2 you two
Laura BPVS score 41 Age 7 y 6 m	Maxi yeah Bye bye unintelligible the box there	Dinah Maxi Dinah and Maxi car yeah x4 out a walk bye Dinah bag a blue that one the tablet
Ruth BPVS score 66 Age 8 y 11m	bye in there x2 yeah	who's that Dinah yeah x11 bye Dinah him he put it in there I can't do it that's a bit close err, the toy back in the bag

		it's in there in there I don't know x2

Table 99. Group 3 Comparison of amount of speech in FB1 and FB3 episodes, by participant

Although much of their speech was still in response to the researcher's questions, the children contributed much more in the FB3 episode. Ruth in particular changed not only how many utterances but also the length and complexity of them.

This change in verbalisation may be as a result of two elements. Firstly in FB1 they were introduced to the Dinah/Maxi story and so they had to focus on following the story. By FB3 they had heard the story twice and many of the group were able to remember the characters and the plot. This may mean they were not using as much working memory to process the immediate task and therefore had mental capacity to generate more speech.

Secondly the children were much more involved with the FB3 episode; they were encouraged to act out the story themselves using the dolls, to make decisions about where the toy wold be hidden and to take photographs of key moments using the tablet. This may have given the children more opportunity to engage verbally either in response to researcher's questions or by commenting on their own actions. In addition to these aspects of the episodes, the FB3 episode also took place towards the end of the session, the 'stranger effect' of the situation and the researcher may have lessened as the session wore on.

Throughout the session the children used 3 main types of speech; speech in response to a question, repetition of the researcher and independent speech.

	Speech in response to a question	Repetition of the researcher	Independent speech
Misha	(In between tasks) R: what can you see Misha: apple R: that's right that's an apple.	R: can she hide her toy? Misha: hide…toy R: can she hide	*(plays with box – puts toy back in and hides it under the table)* Misha: where? R: where, good girl, are you doing my job?
Anna	R: what colour's this cupboard? Anna: green R: green	R: that's right, inside the white cupboard Anna: (whispers) white	Anna: stairs R: yeah that's some stairs. Anna: round there round there R: that's right Anna: and there

Laura	R: Laura, where did Maxi hide the toy? Laura: the box R: good talking	R: Ok this time her special toy is a car Laura: car	(WM) R: can you point to 5,4 Laura: finished R: alright that's fair enough
Ruth	R: Ruth, where did Dinah put the toy? Ruth: in the bag	(BPVS) R: jogging Ruth: jogging (whisper) R: well done	R: shall we find him where is he Ruth: there R: there he is Ruth: that's a bit close

Table 100. Group 3 Types of speech used by participants. All examples from a FB episode unless otherwise stated

Both the repetition and the answer types of speech tended to be used within tasks and were often limited to one or two words. For Anna, Laura and Ruth their independent speech was more directive (as in Laura's example in Table 100) or descriptive (as in Anna's example in Table 100) and often used more than one or two words. This suggests that eliciting speech through questioning may not be an effective way of encouraging this group of children to use and widen their vocabulary.

Two of the participants, Misha and Ruth, repeated the researcher's words during the BPVS.

Misha - BPVS		
Pointing	Eye contact/focus	Speech/speech sounds
Points as says word	glances away then back to pics	R: duck Misha: duck R: good talking
hesitates whilst says the word	looks at pics then to R after choosing then back to BPVS	R: mouth Misha: mouth R: good girl
points at a picture then signs on arm Points again after R says jumping	focussed on BPVS	Misha: *(before R says word)* dud (jump) R: listen to the word. Jumping good girl that was lovely signing
points to cake then to spoon when prompted	looks over the top of the BPVS after pointing – perhaps to TA?	R: spoon Misha: ta (cake) Misha:spoon R: good girl nice talking
Ruth - BPVS		
mouths word whilst looking at pics		R: delivering good looking Ruth
	glances to R	R: desk Ruth: desk (whisper)

		good
	focussed on pics	R: jogging Ruth: jogging (whisper) R: well done
smiles as she points	focussed on pics	R: binoculars you spotted those
mouths word	focussed on pics	R: astronaut well done

Table 101. Group 3 Misha and Anna repeating the researcher's words during the BPVS

Both of the examples in Table 101 were at the beginning of the BPVS, after these examples Misha repeats another three words during the task, Ruth repeats another five.

Participant	Word repeated	Set given in BPVS	Correct pointing	Incorrect pointing
Misha	duck	1st	✓	
	mouth	1st	✓	
	jumping	1st	✓	
	spoon	1st	✓	
	apple	1st	✓	
	aeroplane	2nd		✓
	dancing	3rd		✓
Ruth	delivering	1st	✓	
	desk	1st	✓	
	jogging	1st	✓	
	astronaut	1st	✓	
	jewellery	1st	✓	
	rough	2nd		✓
	vehicle	2nd		✓
	sorting	2nd	✓	
	bannister	3rd		✓

Table 102. Group 3 Misha and Ruth's repetition of words and pointing patterns during the BPVS

As seen in Table 101 for both participants there was no consistency with their correct or incorrect answers according to whether they had repeated the word or not. Both girls repeated more at the start of the BPVS, perhaps indicating that they were working out the task requirements and the rehearsal helped them to retain the word whilst also remembering the task instructions. That the children repeated words during their first set of pictures in the BPVS (Ruth and Misha started on different sets of pictures, appropriate for their ages) suggests that these words were in their vocabulary. This may mean that later words which were repeated but an incorrect picture was pointed to, were in fact within their vocabulary but they were unsure of how they might be pictorially represented.

Considering the areas in speech and signing identified in group 1 and group 2, the analysis from group 3 offers some interesting developments, as well as some additional areas for exploration:

a. *Communication is not always recognised as a 2-way exchange.*

In groups 1 and 2 the participants' use of speech and sign was not always specifically directed to the researcher, there seemed to be a limited understanding that to see/hear is to know. This is reflected somewhat in group 3, where a lack of eye contact during communication may indicate this theory is not securely embedded. However, in group 3 the participants took part in the questions and answers and responded appropriately to the researcher, so appeared to have an understanding of the nature of communicative exchanges.

b. *Communication can be used to redirect the task or situation.*

By group 3 this theory appears to be securely embedded and some of the children use sophisticated verbal means to redirect the researcher to their own knowledge and interests.

c. *Questioning may not enhance communication*

That the children's responses were more extensive when they were self-directed may indicate that when given this freedom they are more able to generate and produce longer, more complex sentences.

d. *Action may promote speech*

All the children spoke more in the FB3 episode where they were able to act out the story; FB3 gave rise to longer sentences and more description. This may also have been as a result of reduced questioning and intervening by the researcher or that the children were more comfortable with the testing situation.

9.2.3 Gestures and pointing

Similar to groups 1 and 2 the use of gestures in this group was limited, perhaps even more so. Most gestures used were culturally defined (nodding, waving) with the exception of Misha and Anna, who used some gestures to aid their description.

Misha - BPVS	
Gesture	Speech/speech sounds
points at picture of belt and moves finger round	Misha: Round
Anna - BPVS	
mimics bow and arrow	R: oh yeah, she's got a bow and arrow hasn't she. Anna: unintelligible

Table 103. Group 3 Misha and Anna using gestures for description

In both of the instances in Table 103 the children are describing, through gesture, something they potentially do not yet have the vocabulary for. Through gesture they are able to communicate some component of the picture to the researcher.

The children also used pointing to share information and knowledge with the researcher, although the interplay between pointing and communication was more complicated than that of the gesturing. Initially the children were asked to use pointing to show their knowledge in the BPVS, for many children in this group, as in group 2, this proved a difficult skill to sustain. All the children began the BPVS paying attention to the pictures and the researcher, pointing accurately at the pictures, but as the test continued their pointing became more erratic and unclear.

Misha - BPVS

Pointing	Action	Eye contact/focus	Speech/speech sounds
points at zip (almost without looking)	rubbing head, moves head down towards the table	looking vaguely at BPVS, then at table	R: listen belt
points very quickly to incorrect without looking at BPVS		looks up to R	R: look at me Misha, belt good girl
points at tractor (before looking at all pics)	bend up over the table	looking at BPVS, then at R's papers	R: farmer well done
points before word is said		at BPVS	R: thumb
points before word is said			R: listen castle *loud back ground noise (counting in French)*
points to house (incorrect) after asked 2nd time points in a vague way	smiles at R, then when she asks again bends head down over table	looks at BPVS and then up to the R when signs home, then looks down at table, then looks up to BPVS and then immediately up to R after pointing and smiles	Misha: unintelligible, (then signs home) R: castle. that is a house you are right which one is castle
points in a cursory way incorrect	leaning across the table, leg up in the air		R:listen, empty, empty

Table 104. Group 3 Misha's pointing during the BPVS

Misha's focus appeared to be waning in the example in Table 104; she was finding it difficult to concentrate and was physically very active. Her incorrect answers may not have been indicative of her actual verbal comprehension level, but more indicative of her lack of focus and ability to persevere when the task became increasingly difficult. Her pointing became vague and she often pointed before the word had been said or without really looking at the pictures.

Laura and Anna also showed erratic and irregular pointing behaviours such as pointing before a word had been said, not looking the pictures before pointing and pointing in quick succession to more than one picture. This level of irregularity was not confined to the BPVS; all the children in this case series study also found pointing at the number line difficult in the working memory task. They all used 2 hands to point to 2 numbers, rather than point to the numbers in succession. This meant pointing to three numbers was very difficult. Some of the children also used a full hand point, possibly to disguise the fact they were unsure about what to point to.

If pointing in these two tasks was so irregular there must also be a question over how reliable the participants' pointing was in the FB task. Although the children appeared to be making a choice, it is worth questioning whether they were able to control and monitor their own pointing.

Considering the pointing and gestural behaviours of groups 1, 2 and 3, the continued themes for discussion are:

a. *Gestures are culturally defined rather than an addition to language, or used in imitation.*

In fact in this group, most gestures used were culturally defined. There were fewer gestures and these most consistently these came from the child with the most limited verbal language.

b. *Pointing may be used as a communicative (instrumental) device.*

In this group the children had begun to use pointing to communicate their answers, albeit in an irregular way. They appear to understand how pointing works as a way to direct your partner and show your knowledge. No pointing to distract the researcher was seen. However, see point c.

c. *Pointing may not be a reliable indication of knowledge or ability in this group*

Children's pointing was so erratic and unreliable that it may not be an effective way of eliciting children's knowledge.

9.2.4 Body language and social interaction

In analysing this area, as with groups 1 and 2, clear themes began to emerge. Some which were specific to this group and others which follow on from group 1 and 2 analysis. Redirecting the task is a common theme in all 3 groups, but task interpretation and small world play will also be discussed in this analysis.

Redirecting the task

As with group 1 and group 2 analyses, much of the children's interaction was focussed on redirecting a task through a variety of means. The redirection falls loosely into 3 categories, all of which have been seen at various points with groups 1 and 2:

a. changing the task to self-directed play
b. refusing the task
c. engaging with the researcher – sharing knowledge

a. Changing the task to self-directed play

Three of the 4 the participants in this case series attempted to change the task by playing with the equipment in a different way than the researcher was requesting, as is seen in Table 105.

Participant	Example of redirection
Misha – WM	Points to all numbers in backward sequence and recites them. When gets to the end takes number line and turns it over.
Anna - BPVS	Turns the page of BPVS herself after choosing, tries to turn folder round. Turns the next page, then moves BPVS to show TA the pictures.
Laura – FB3	R: ok, who's going to come back? Laura picks up Maxi and makes him 'go out' R: oh is he going out as well, I think we need to have them both in, shall we have them both in? Laura: yeha

Table 105. Group 3 Misha, Anna and Laura changing the task to self-directed play

In each of these examples, although all the participants are self-directing, they appear to be doing it for different means. Misha was finding the WM task very difficult and was disengaged with the task, by directing her own play she was able to show the researcher that she *was* able to do, what she felt she could succeed in. In this instance the off task behaviour may have helped the participant feel re-engaged and successful. Anna however may have been trying to control the play herself. She was displaying signs of boredom just before the sequence in Table 105 and then took over the play. Laura redirects the episode by changing the story and making the Maxi doll 'leave the scene'. Shortly after this example, when the researcher attempted to ask the key questions, she took the dolls and threw them into the researcher's box, finishing the task. Laura may have been changing the story line to prevent the researcher from asking the questions she found hard to answer.

b. Refusing the task.

Two participants used physical means to finish a task before the researcher had completed it.

Participant	Example of redirection
Misha – FB3	Picks up Maxi and throws him away in R's box. Throws all the other toys in the box. Lays on the table.
Laura – WM	Laura folds up number line R unfolds number line R: can we try one more? Laura: yeah R: one more good thank you R: can you point to 5,4 Laura folds up number line and says 'finished'

Table 106. Group 3 Misha and Laura physically redirecting a task

Both of the participants in Table 106 were finding the tasks difficult and were possibly finding a way to end the task because they were uncomfortable with the task difficulty.

c. Engaging with the researcher – sharing knowledge.

Misha and Anna both engaged with the researcher at a number of points in order to share their knowledge with her (Table 107). It could be that, as they found the tasks difficult, they were keen to direct the researcher to something they found more interesting and more available for them to discuss.

Participant	Example of redirection

Misha – BPVS	R: hopping Misha: *(points to picture)* look R: what's she doing Misha: *(gestures climbing)* eh R; that's right she's climbing isn't she this girl.
Anna – FB2	Anna: *(pointing at steps in picture)* stairs R: yeah that's some stairs. Anna: round there round there R: that's right Anna: and there

Table 107. Group 3 Misha and Anna engaging with the researcher to share their own knowledge

All the above examples give an indication of the variety of means the children employed to move away from a task which was either not engaging or too difficult. These strategies are very similar to those identified in groups 1 and 2 with a key difference in verbal language ability. The children in this group were more verbally adept (which may be a group effect as much as an age effect) which gave them an added skill to employ when avoiding tasks.

Notably absent in the above tables are any examples from Ruth. Ruth remained on task throughout the entire session and completed all the tasks without requesting to stop.

Task interpretation and prior knowledge

In an attempt to understand why the children's approaches to the tasks were so different, the response of each participant to the key questions in the FB episodes was examined, considering what knowledge they appeared to bring to their answer. It is possible that the prior knowledge the children brought to the task directly influenced how they interpreted the FB task. For example, Misha appeared to interpret the FB task as a simple 'where is' game. This is shown by her own game at the end of the session in Table 108.

Misha – FB3		
Action	Eye contact/focus	Speech/speech sounds
plays with box – puts toy back in and hides it under the table		
pops up from below table		Misha: Where? R: Where? Good girl, are you doing my job!

takes lid off box and shows it to R	looks toward R, looks at box	Misha: ah. dudu. R: did you find it?

Table 108.Group 3 Example of Misha recreating the FB task using a 'where' game

Misha's understanding of the storyline could have been limited to each doll hiding and then finding the toy; an understanding based on desire psychology without the complexity of belief, similar to that outlined by Wellman (1990) in his description of 2 year olds. Therefore when she is told a doll wants the toy, she finds it for them. Although she understood the nature of hiding, it doesn't appear that she was clear on the nature of hiding *so someone else doesn't know where it is*. A common mistake young children make when playing hide and seek (Peskin & Ardino, 2003), which is evidenced in her asking the researcher 'Where' in the above example (the researcher has just seen her hide the box). Misha's theories of the physical world (her naïve physics) and of others' psychology (her naïve psychology) were potentially not yet at a point that she understood 'to see is to know', or more importantly in hide and seek, 'to not see is to not know'. Misha's responses to the FB1 questions were to reach for the box where the toy was hidden (in fact before the researcher could finish the questions), this could indicate that her primary concern was that the Dinah doll got the toy she desired and the questions were somewhat superfluous.

Anna's responses were very mixed; in her FB3 answers she found it difficult to conceptualise the toy in any place other than where it actually was. She responded by pointing to the current whereabouts of the toy, as though the only question being asked was 'Where is the toy?'. If Anna's prior knowledge did not include secure schemas of 'time' or 'past' then she may have only comprehended the task within the present tense. The questions regarding where the toy *was* hidden, may have been understood as 'where *is* the toy'. This misunderstanding may not be a language comprehension difficulty, but a lack of conceptual framework regarding time and sequencing. Anna's other responses are more complex, in both FB1 and FB2 she pointed to the incorrect places of where the toy was originally hidden and it's current whereabouts (i.e. she got these answers the wrong way round), but the correct place of where Dinah would look for the toy.

Anna – FB1		
Action	Eye contact/focus	Speech/speech sounds
takes doll from R and makes Dinah 'look' in the drawer	focussed on Dinah and then drawers	R: where is she going to look for her toy? Anna: there
opens drawer and finds it empty, goes to box and opens it	focussed on own actions, looks up to R when she finds the toy	Anna: in there R: it's not in there Anna: there

Table 109. Group 3 Anna's response to the final question in FB1

In the example in Table 109 Anna would not point to her answer but took the Dinah doll from the researcher and 'made her look' in the drawers. This would seem to indicate that Anna was able to attribute some internal life to Dinah, by 'making her real'. Although during this session Anna did not get any FB episodes correct, during her second session she did pass one of the episodes. This suggests that Anna could be *developing* a psychological theory of false belief, similar to the sequence of unpredictable passing and failing suggested by Flynn et al. (2004). Possibly her developing theory of false belief was undermined by lack of a secure foundational knowledge of time and sequencing, particularly with reference to temporal vocabulary ('is' and 'was').

Laura, however, appears to bring some prior knowledge of time to the tasks. She was able to accurately remember where the toy *was,* and know where the toy currently *is*.

Laura – FB1			
Pointing	Action	Eye contact/focus	Speech/speech sounds
		glances up to the R's face – before she says her name. Then watches her hands	R: Laura, where did Maxi hide the toy?
points to the box		looking at the box	Laura: the box R: good talking
points to drawers		watches R's hands signing then looks at drawers	R: where did Dinah hide the toy? good looking,
	reaches towards the box, picks it up and opens it. R takes box and puts lid back on and places back on the table	focussed on box	R: well done, so, oh waiting, put the lid back on Laura: (unintelligible) R: just put it back on that's it
		looks to Dinah, follows Rs hands	R: so when Dinah comes back in and she wants to

			look for her toy where is Dinah going to look
points to the box		looks at box	Laura: there

Table 110. Group 3 Laura's correct answer to the memory and reality questions, but incorrect answer to the FB question

Laura's consistent answering of the memory and reality questions, on all three FB episodes, shows that her schema for time was at such a level she understood that a state had occurred and that it no longer existed (the toy *had been* in the drawers, even though it was no longer there). Laura's interpretation of the task appeared to be as memory game, answering questions about where the toy was and is. Potentially her lack of understanding of the final question as psychological, rather than physical, means she misinterpreted the question. Perhaps what Laura found difficult was the concept that Dinah did not know that the toy has been moved; that she had a false belief. Laura's false belief schema may not be sufficiently secure for her to be able to answer the false belief question correctly all the time. That Laura was able to pass the FB2 but not the other two episodes may show that she was developing and testing out her theory of mind theory but it was in conflict with her simpler 'desire' based theory (Dinah wants the toy so she will go to the place where it is). This inconsistent passing of the false belief task is consistent with that seen in the Flynn (2006) study.

For Ruth however there appeared to be no such conflict; she securely answered all three questions correctly on all the episodes in both her sessions. She appeared to bring to the task her prior knowledge of time, sequencing, memory, and crucially an understanding of mental life. She bestowed on Dinah not only false belief, but by FB3 a problem solving ability. A seen in Table 111, after she had made Dinah hide her toy in her bag, she tried to make sure Maxi wouldn't be able to get it by making Dinah leave the scene with the toy in her bag:

Ruth – FB3		
Action	Eye contact/focus	Speech/speech sounds
	looking at the toys	R: and now what's Dinah going to do?
makes Dinah pick up her bag and starts to make her 'go out'		
		R: she's going to take her bag is she? Ruth: yeah

Table 111. Group 3 Ruth using problem solving to prevent Maxi getting the toy

Even though Ruth was able to utilise her understanding of naïve psychology to pass the task, she was unable to explain Dinah's internal state.

Ruth – FB3		
Action	Eye contact/focus	Speech/speech sounds
takes bag from R, makes Dinah look in the bag	looking at bag, smiling	R: what's going to happen when she looks in the bag? Ruth: in there
playing with toys	looks at R	R: oh, what's she going to think Ruth: I don't know

Table 112. Group 3 Ruth and the researcher discussing the FB task

Although in the example in Table 112 the researcher only asked the question in passing (it wasn't part of the task), Ruth was unable to further express Dinah's false belief. This is similar to how typically developing children initially respond to questions about false belief; they are able to pass the task but are unable to explain how they reached their conclusion (Amsterlaw & Wellman, 2006).

The 4 children in this case series appeared to bring a variety of prior knowledge to the tasks which may have impacted on their interpretation. Their responses to the tasks may have been dependent on where they were in developing their naïve theories of physics and psychology.

Small world play

A key feature of the FB task, which is automatically assumed when using the tasks with typically developing children, is that the participants are able to attribute character to the dolls. There is an assumption that when the researcher presents the dolls, the children will know that they are expected to pretend they are biological entities with internal thoughts. On reviewing the case series videos, it became apparent that the children in this study were not reliably able to do this. Small world play requires a similar ability as pretend and symbolic play in that it requires the child to take on a dual role, that of a narrator and that of the character. It is akin to symbolic play in its nature as it requires the understanding of the symbolic function of the small world figures; they are representing the real thing (Bretherton, 1984). When engaged in small world play children use the figures as puppets, speaking for them and attributing physical and mental states to them. Only Ruth was able to instinctively do this.

Ruth – FB3		
Action	Eye contact/focus	Speech/speech sounds
	glances at R then back to toys	R: I think she might be a bit sad Ruth: yeah R: yeah and she'll have to ask Maxi, Where's my toy? Where's my toy?
Holding the dolls, acts out Dinah asking Maxi	looking at toys	Ruth: I don't know (being Maxi)

Table 113. Group 3 Ruth using the dolls in small world play

In the example in Table 133 Ruth was able to make the dolls 'talk' to each other and even affected a different voice for Maxi. She could pretend the dolls were biological and psychological entities who had the same attributes as real people.

The other three children in this case series study did not show the same signs of attributing a psychological life to the dolls, but Laura and Anna did show some understanding of pretending the dolls were *biological* entities who *do* physical things. In the example in Table 114 they are able to suggest new things that Dinah could do when she goes 'out', unprompted by the researcher.

Laura – FB3	
Eye contact/focus	Speech/speech sounds
focussed on the toys	R: Bye. Where's she going to go this time Laura? Laura: out a walk R: out for a walk? Laura: yeah

Anna – FB3	
focussed on own activity	R: where's Dinah going now? Anna: swimming R: she's going outsi…she's going where? Anna: swimming R: she's going swimming, ok, that's fine she can go swimming that's good, bye Dinah

Table 114. Group 3 Laura and Anna attributing physical actions the Dinah doll

That Laura and Anna were able to do this suggests that, whilst their understanding of naïve biology is developing (living things have actions) and they could attribute this to the dolls, they had not yet developed an understanding that living things also have mental states, or psychology. They were able to make the dolls 'do' but they were unable to make the dolls 'be'.

That all the children are able to attribute ownership to Dinah may appear to contradict this argument:

Misha – FB1		
Action	Eye contact/focus	Speech/speech sounds
R takes Dinah doll. Moves drawers as Misha tries to get them. Shows the toy, moves it into her eye line	looking at toy and drawers	R: Dinah has got a special toy. Here. Are you looking? can you see? that's Dinah's special toy. Can you give it to her
Misha takes it and gives the toy to Dinah	Focussed on Dinah and the toy	R: That's right. Its really special
Anna - FB1		
takes toy from R, then holds it up to Dinah	looks at toy then out window?	R: look, this is Dianh's special toy. that's her favourite toy. that's Dinah's favourite toy. that's right it her's
Laura – FB1		
takes toy when R hands it to her	watching R's hands	
puts toy on table	watching the toy	R: so Dinah has got a really special toy, look. it's her favourite toy
Laura puts toy near Dinah, Dinah falls over, R sits her back up	looking at toys	R: can you give it to Dinah? that's it oh Dinah!

Table 115. Group 3 Misha, Anna and Laura attributing ownership to the Dinah doll

Although in the example in Table 115 Misha and Laura are prompted to 'Give Dinah the toy' by the researcher, all three children are able to show that Dinah 'owns' the toy by giving it to her, and later helping her to hide it and then find it.

However, the ownership that is attributed may well belong to a physical understanding of belonging together (i.e. categorising) rather than on a psychological level. Giving Dinah her toy attributes ownership, but doesn't necessary confer on her a character or inner life. For example ownership terms are used about inanimate objects, for example 'that toy belongs in the garden'. This doesn't imply that the garden has a psychological life, but it does suggest that the garden 'owns' the toy, or at the very least that they belong together. That all the children in the case series are able to do this suggests that they have begun to understand categorising and ordering, an essential skill in their cognitive development (Tager-Flusberg, 1985).

In following these four children's interpretations of the FB task it is possible to suggest areas of the children's development which impact heavily on their ability to access the tasks, and which potentially affect the way they behave and respond to the tasks.

a. *Prior knowledge influences how the children perceive the task.*

   Because of the lack of homogeneity in this group and the way data has been analysed it is possible to suggest that the prior knowledge children bring to the tasks has a profound effect on the way they perceive the task. It can be suggested from the case series analysis that children who have no understanding of the psychological theory that we all have 'minds' are unable to perceive the task as anything other than a hide and seek task. Those children who lack sound knowledge of 'time' and 'sequencing' are unable to access the comprehension detail of 'is' and 'was' in the questions. When this understanding begins to develop access to the memory and reality questions may be enabled, but it may be not until all these areas of prior knowledge and psychological theory building converge that children are able to pass the tasks.

b. *Off task behaviours may indicate a lack of foundational knowledge.*

Three children in this case series study behaved in a variety of off task ways, all of whom found the tasks difficult, possibly because of their lack of foundational knowledge. Much of the off task behaviour was designed to engage the researcher with a topic the child wanted to communicate about, potentially bringing the session back within the child's understanding. The 1 child who was able to pass the tasks did not display any off task behaviours.

9.2 Group 3 - Interim discussion

From the quantitative and qualitative data discussed above a developmental pathway that the children in this group may take can be suggested. The analysis of their pass and fail rates has little to offer in this account but the way they moved from passing to failing, as evidenced in their error patterns, gives some potential insight. Coupled with behavioural observations it is possible to suggest that the children in this group follow a similar pattern of moving from failing to passing the False Belief task as typically developing children, but with some potentially important differences in the way this is achieved and the time it takes.

One child in this group, Louis, was unable to access any of the tasks set. As has been stressed right through this work, it is of upmost importance that every child in the study is included in the analysis as they represent the heterogeneous nature of individuals with Down's syndrome. As Louis could not perform any of the tasks it could be concluded that he did not have any of the skills which he was being tested for. However it may equally be suggested that the tests were not presented to him in the right way, or that, had he been presented with tasks from group 2, he may have shown some engagement. Louis was able to follow instructions (such as 'hide the toy in the drawer') and did show some engagement with the Dinah/Maxi story. As he did not answer any questions his interaction could not be recorded in the quantitative results nor, as he was not part of the case series, in the qualitative results. However the clear focus of this research on ensuring all children with Down's syndrome, regardless of perceived ability, are considered in research and practice runs throughout the following Whole Group analysis, Impact and Further Research chapters.

One of the main responses observed in this group was the use of the error-correct-error (Salience) strategy to answer the questions. This response suggests that the children were unable to restrict their prepotent response of pointing to where the toy actually is. These children may have a lack of inhibitory control, as suggested by Borella et al. (2013). This would not be unusual in the development of theory of mind skills as Flynn et al. (2004) and Perner and Lang (1999) suggest that executive controls are an important development which happens before (Flynn et al., 2004) or at the same time as (Perner & Lang, 1999) false belief understanding. However for children with Down's syndrome it may take much longer for them to develop the required control to prevent their prepotent response (Rowe et al., 2006).

At this point in development the children in this study may have been using prior knowledge in the form of schemas for ownership and categorisation (Mervis & Pani, 1980), but these may not support the mental understanding implied in the story. Level E1 representations allow the exchange of 'procedural components' (Karmiloff-Smith, 1995, p.20.) across domains to follow the practical elements of the story, but representations may not enable a social interpretation of the story. Understanding may be further constrained by poor concurrent processing and storage (Carney et al., 2013) and the demands on weak executive functions (Carney et al., 2013; Lanfranchi et al., 2010) may make accessing the tasks very difficult. Children using skills at this point in development may be using a range of off task behaviours, such as 'where' games, verbally engaging the researcher and playing with the dolls, to move the session to a level they feel more comfortable with. This suggests that they may have an implied understanding of 'I know that I don't know' but may be unable to articulate this or indeed even have a metacognitive understanding of their own abilities (Kuhn, 2000).

The children in this study appeared to develop in the way they responded to the FB task by employing memory strategies to answer the first two questions correctly. This implies that changes have taken place which have a) released some of the constraints on the working memory system and b) allowed for the development of schemas regarding time-sequencing. The working memory system can now recall both places in which the toy has been hidden, suggesting a potential increase in capacity or that capacity has been ‘freed up’. A new ability to supress the prepotent response (pointing to where the toy actually is on all three questions) is also apparent, suggesting that the inhibitory response mechanism has developed. Perhaps a newly developed understanding of temporal sequencing, usually seen by 3 years old in typically developing children (Bauer & Mandler, 1992), enables the child to organise its memory effectively allowing for correct encoding and retrieval. Representational ability may not be very different than in the children described above, it appears still grounded in an empirical understanding of events (Rast & Meltzoff, 1995) and does not yet take into account hypothetical situations.

This is evidenced in the children’s inability to judge the doll’s actions on anything other than a desire based reasoning (Dinah wants the toy, so she will go to the place where it is). Bartsch and Wellman (1995) suggest that even when desire reasoning is developing into a belief/desire psychology the desire aspect is more potent for the child and they are unable to supress the desire over the belief (although Wellman has since gone on to slightly review this stance in (Wellman, 1990). Representations may still be constrained by the sharing of ‘procedural components’ rather than the consciously available representations which Karmiloff-Smith describes at level 2 explicit (Karmiloff-Smith, 1995).

The children at this point of development appear to have some ability to attribute actions and ownership to the dolls, suggesting they understand others at least as biological entities who can ‘do’ and can ‘have’ (Wellman, 1990). These children are good at using a variety of skills such as using speech to talk about their own interest, playing with the toys and refusing to engage, to redirect the researcher. This suggests they could be using their social cognition to control the test situation, even though they may not be able to use it in the false belief task. This is supported by Dunn (1988) who describes typically developing children's early use of social understanding in social situations such as arguments with parents and playing with siblings, far earlier than is seen in experimental work.

The children in this study seemed to move from using a Memory response in their answers to the questions to using mixed strategies which incorporated the Memory, Salience and Correct responses. It could be that children at this point in development are using some trial and error type strategies in order to work out the correct response to the task (however this is complicated in the FB task as the correct response results in finding no toy). Children using these responses may *look* to the correct place either when Dinah comes back in to find her toy, or when the researcher asks the final question, suggesting they are developing an implicit understanding of false belief, similar to finding in typically developing children of around 2 ½ - 3 (Clements & Perner, 1994).

An implicit understanding shows that the children seem to be able to ascribe beliefs and desires more securely and they may be developing their understanding that Dinah's belief does not align with the true state of the world. This is seen in the way children at this point are beginning to act out with the dolls, ascribing to them desires (Dinah wants her ball) or creating novel actions for them (Dinah is going swimming). However old schemas persist, such as action based only on desire, which leads them to use a range of strategies to attempt the task. This instability of response leading up to secure performance in false belief tasks was also found in Amsterlaw and Wellman (2006) and in Flynn et al. (2004).

Children at this point may be undergoing a period of representational change which sees the sharing of information across domains which are now accessible to consciousness, as in level 2 of Karmiloff-Smith's theory of representational redescription (Karmiloff-Smith, 1995). This may account for the children's ability to modify their responses in so much as they are consciously able to monitor their own behaviour. It could be suggested however that this level of representational ability is not secure at this point. Representations and the development of schemas may still be restricted by the simultaneous spatial working memory which is unable to process following where the toy is in the story and simultaneously following Dinah's false belief. Although Dinah's false belief may not appear to need a spatial representation, in order to understand her false belief the child must spatially represent her being out of the 'room' and therefore unable to see (and therefore know) that her toy has been moved.

Language comprehension barriers may still exist for children working at this point, particularly when attempting to decode the final question. Children need to be able to understand the implied part of the question 'Where will Dinah look for her toy *given that she did not see it being moved?'*. Without understanding this the question may still be interpreted as 'Where does Dinah need to look to find her toy?'. It may be that developing this linguistic understanding is an essential component to being able to develop false belief understanding (San Juan & Astington, 2012). The phonological loop system may also be implicated (Jarrold, Baddeley, & Phillips, 1999), potentially impacting on how well the children can remember and store the questions.

The final response seen in group 3 was an ability to answer all the questions correctly all the time. When discussing this however, we must bear in mind that this was only observed in one child in group 3. However, other children did use the correct response some of the time, so examples from their responses can also be drawn on. The children working at this point seem to have an understanding of false belief. Their underlying schemas have changed to support the idea that people's beliefs do not always align with the true state of the world, and potentially many schemas are able to be called upon at one time (for example, a hiding schema, a 'to see is to know' schema, an 'ownership' schema as well as a 'false belief' schema). A developed representational ability, potentially at a level E2 of Karmiloff-Smith's description, allows for the interaction of these schemas to problem solve (Karmiloff-Smith, 1995). The children have now developed a meta-representational ability; they can represent the contents of other's minds and can use that information to inform their own thinking (Perner, 1991). Or in Wellman's (1990) terms they have developed a subjective interpretive model rather than a direct - copy model. However it still appears that, for the children in this study, the movement to Karmiloff-Smith's E3 level of representational ability may not have happened (Karmiloff-Smith, 1995). This level is an explicit level of conscious representation which is able to be described linguistically. Although there has almost certainly been some development in language comprehension in order to access the final question, gains in expressive language may not have been as successful and therefore may prevent articulation of knowledge. Amsterlaw and Wellman (2006) found that verbal mentalistic explanations were the last kind of explanation to be developed with typically developing children.

That children working at this point can follow the task's practical elements and simultaneously follow Dinah's beliefs suggests that their working memory and executive functions have developed to a point which no longer constrain this skill. This is not to suggest that these systems are now working effectively as we know that adolescents and adults continue to have difficulties (E. K. R. Bird & R. S. Chapman, 1994; Rowe et al., 2006) but they may be working at a good enough level to allow for the task demands. Similarlily the phonologial loop system may be working at just enough capacity to retain and store the questions. Children at this point are able to engage in small world play to attribute beliefs, desires and false belief to inanimate objects (in this case, dolls).

Through the description of the quantitative and qualitative data, a pattern of development towards the acquisition of theory of mind has been outlined. This develomental pattern follows loosley that which is seen in the typically developing population. However, the routes which a child with Down's syndrome may have taken to achive this may be different. Constraints from working memory, execuitve functions, prior knowledge and representational ability may all impact on the child's ability to develop their theory of mind, and may force the child to use alternative means to express their knoweledge. The particular tradjectory described above is outlined below in Figure 21 which shows how the development of social cognition and theory of mind may occur in children with Down's syndrome. Table 116 describes this trajectory by linking the observations from this study to prior research.

9.3.1 Group 3 - Simple description of the development of theory of mind skills observed

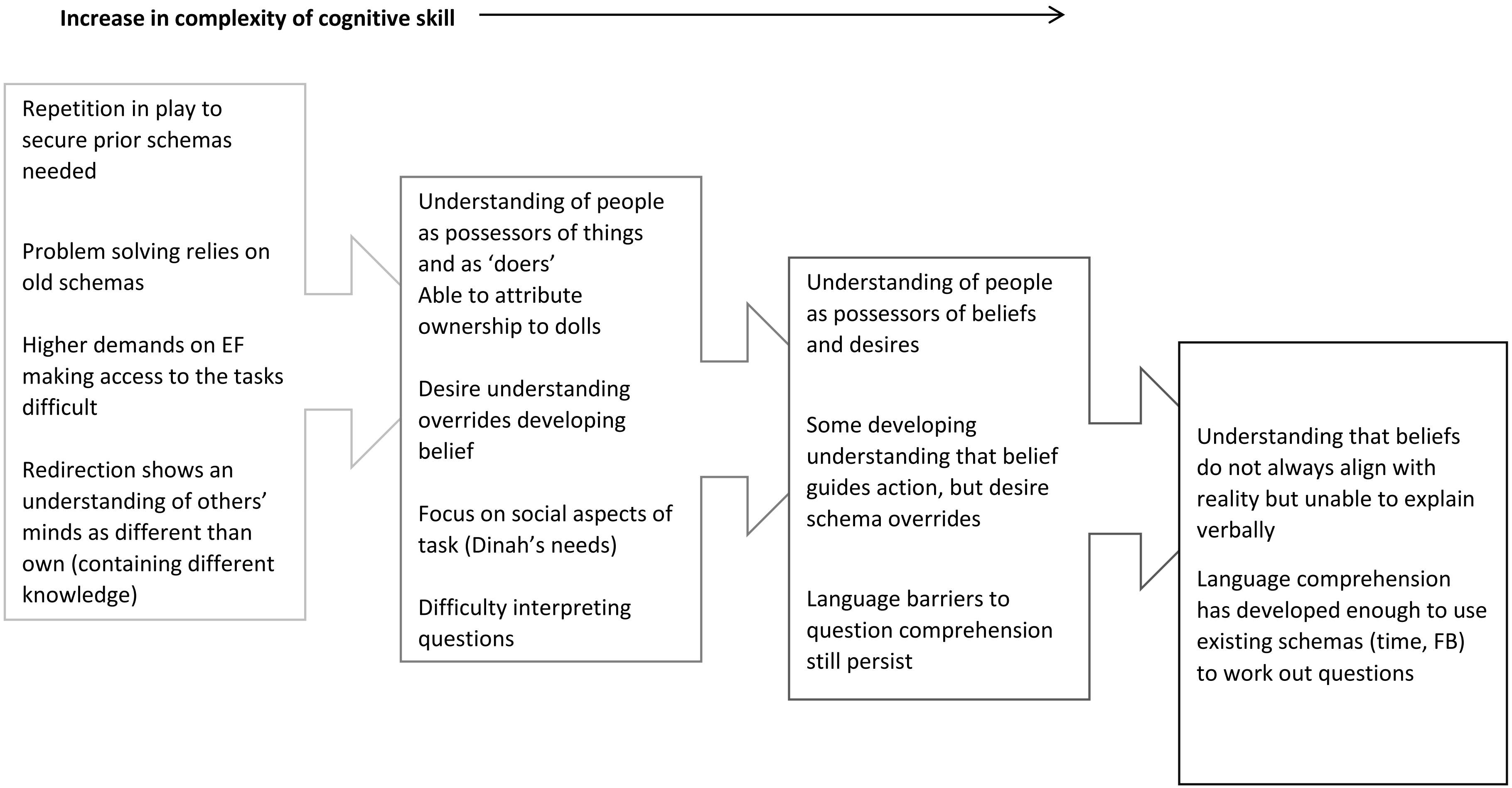

Figure 21. Group 3 Simple description of the development of theory of mind skills observed

9.3.2 Group 3 - Synthesis of qualitative and quantitative data and prior research

Increase in complexity of cognitive skill ↓	**Qualitative and quantitative data linked to prior research →** Description of qualitative behaviours observed	Description of quantitative findings	Prior knowledge and schemas	Representational ability	Working memory and executive function	Development of social cognition/theory of mind
	Child plays own simple game, such as 'where' to engage the researcher Redirects the researcher by refusing the task or using speech and sign to talk about something else Grabs at toys before questions are finished Gives the toy to Dinah—wants Dinah to have her toy back? Remembers the plot and character names	Fails all FB episodes Uses Salience (Error-Correct-Error) response Off task behaviours recorded Inconsistent pointing in the BPVS, uses pictures as a way to distract the researcher	Play schemas limited to dolls as objects rather than symbols Simple ownership schema (things belonging together)	Representations at level E1, elements able to be shared across domains Representations allow following of story	In task inhibitory control unable to prevent prepotent response (salience) Storage capacity able to retain story but cannot concurrently store and process	Repetition in play to secure prior schemas needed Problem solving relies on old schemas Higher demands on EF making access to the task difficult Redirection shows an understanding of other's mind as different than own (containing different knowledge

	Redirection through engaging researcher Attributes ownership and action to dolls Follows events accurately Looks between the researcher and toys on key questions	Fails task Memory response (Correct—Correct—Error) Off task behaviours recorded	Time schema in place Belief/desire schema developing? Dolls as symbols developing	Dual representation allows for pretend play with dolls Story representation still empirically based	Inhibitory control still preventing the inhibition of salience WM is able to store the detail of the story	Understanding of people as possessors of things and as 'doers' Able to attribute ownership to dolls Desire understanding overrides developing belief Focus on social aspects of task (Dinah's needs)
	Complex redirection strategies Small world play with dolls Follows story events and is able to change them Looks to correct place but gets answers incorrect Looks between researcher and dolls on key questions	Mostly fails task Mixed strategy responses (ECE, CCE, CCC) Some off task behaviours recorded	Belief/desire schema in place False belief schema emerging	Undergoing representational change to be able to use information from a number of domains	Able to supress prepotent response Simultaneous spatial WM unable to process false	Understanding of people as possessors of beliefs and desires Some developing understanding that belief guides action, but desire schema overrides Language barriers to question comprehension still persist

	Attributes ownership, action and a mental life to dolls On task all the time Follows events accurately Shows problem solving abilities Looks between the researcher and toys on key questions	Correct response	False belief schema developing A number of schemas in use at one time	Meta representation allows flexible thinking across domains	Executive control developed enough to allow for concurrent processing and storage	Understanding that beliefs do not always align with reality but unable to explain Language comprehension has developed enough to use existing schemas (time, FB) to work out questions

Table 116. Group 3 Synthesis of qualitative and quantitative data and prior research

Chapter 10: Whole group analysis and discussion

This section briefly details a number of analyses which have not been covered so far and which relate all three of the groups in this study.

10.1 Use of prompts

An important element of the testing procedure was that the children were given extended time to answer questions and that they were given prompts to remind them of the task if they failed to engage (see the protocols in Appendix 2). In designing the tasks it was felt important to give the children the time and support they needed in order to access the tasks as fully as they could. However very few children needed prompting to engage with and pass a task.

Group	Prompts resulting in pass	Out of number of trials
1	7	120
2	7	76
3	3	130

Table 117. All groups Number of prompts per group resulting in a pass (not including prompts resulting in task failure)

The figures in Table 117 suggest that the children were either easily able to focus on the task thereby not needing prompts to engage with the questions, or they failed the task (with or without prompts). However this does not mean that they understood the questions or were responding appropriately to them. In fact, many children were observed reaching for toys before a question was finished. This may suggest an understanding that a question was being asked, but the content of the question was irrelevant to the child. An inability to inhibit a physical response whilst listening to input or a question may prevent the child from being able to fully access a task.

From the results in Table 117 it may also be questioned whether repeating a question for a child with Down's syndrome actually helped or hindered them in problem solving and answering questions. It may be that repeating the question forced the child to begin the process of decoding the question from the beginning again, thereby interrupting the child's initial decoding process. The more prompts given the more times the child has to restart their decoding process. By the third prompt the child may have (understandably) given up and therefore a fail is recorded. This could have serious implications for the way questioning is used in schools and by parents and carers. When questions are re-asked, especially if they are rephrased and therefore creates a 'new' question to decode, it may prevent the child from having 'thinking time' and therefore being able to reach an answer.

10.2 Stop card

Four children in group 3 chose to use the stop card during the session to finish a task or to take a break. However 6 chose to finish tasks through other means, such as tidying the toys away or refusing to engage with a task. Since this was a new method for the children to use, there is some doubt as to whether its use was fully understood.

As part of the testing session the adult who was present at the session was given a feedback form to complete (see Appendix 4) which asked for their opinions about the tests and how the child had performed. The carers and teaching assistants responses to the stop card were positive, suggesting that this is a support which may be useful in a range of environments. Table 118 shows comments made by parents and teaching assistants regarding the stop card.

Group and author	**Comment**
Group 2	
Teaching assistant	"Great gives ownership to the child over the activities in a non-verbal way."
Teaching assistant	"Have not used this idea before."
Parent	"Fabian hasn't used this strategy before so I'm not sure if he fully understood this."
Group 3	

Teaching assistant	"Liked the idea of a 'stop' card. It was a simple, straight forward command to let the adults know they had had enough."
Parent	"A fantastic idea. Was worried initially that she would say stop straight away but enjoyed the tasks."
Teaching assistant	"Thomas currently does not express any needs/wants – unsure whether his use of card was used in the correct way."
Parent	"Good idea – though Rose will vocalise when she has had enough."
Teaching assistant	"A great visual piece. Anna didn't need to use it though."
Teaching assistant	"Misha didn't initiate the use of the stop card when she had had enough. It seemed like a good visual back up for confirming that she wanted to finish. I would normally sense that she had had enough and she usually agrees to do ½ more."
Teaching assistant	"Thought it was a useful tool for the child to be more in control of their own self when in a more 'abstract setting' i.e. when not familiar with persons and tasks before them."

Table 118. Parent and TA responses to the use of the stop card

10.3 Language questionnaire

As discussed in Chapters 3 and 5 how and what mental state language is used around a child can affect their ability to label their own and other's mental states (Beeghly et al., 1986; Tingley et al., 1994). In this study very simple information about the types of language used with each participant was collected via a parent questionnaire (see Appendix 3) which focussed on terms for labelling internal states: think, like, want, play, know, remember, pretend, tired, worried, sad and frightened. Tables 119, 120 and 121 show parent reporting, from all groups, of the way they use language around their child.

target word	examples	Never	Once a month	Once a week	Daily
think	'I think it's here.' 'Where do you think it goes?'	II			IIIIIIIIII
like	'I really like this song.' 'Do you like bananas?'			I	IIIIIIIIIII
want	'I want you to go in there.' 'Do you want a drink?'				IIIIIIIIIII I
play	'I'd like to play with this.' 'What are you playing?'			I	IIIIIIIIIII
know	'I know where you're hiding!' 'Do you know whose house this is?'		I	IIIII	IIIIII
remember	'Hmm, I can't remember that.'	III		IIIII	IIII

	'Can you remember where it is?'				
pretend	'It's ok, I'm just pretending to be sad!' 'Can you pretend to be a mouse?'	IIII	II	IIII	II
tried	'I'm so tired, is it bedtime yet?!' 'Are you tired?'				IIIIIIIIIII I
worried	'Is she worried she will be late for school?'	IIIIIII	I	III	I
sad	'Why are you sad?' 'I'm sad because I banged my toe.'		II	III	IIIIIII
frightened	'The little mouse was frightened of the snake'.	IIIII	III	III	I

Table 119. Group 1 Mental state vocabulary questionnaire responses, N=12

target word	examples	Never	Once a month	Once a week	Daily
think	'I think it's here.' 'Where do you think it goes?'		I	I	I
like	'I really like this song.' 'Do you like bananas?'			I	II
want	'I want you to go in there.' 'Do you want a drink?'				III
play	'I'd like to play with this.' 'What are you playing?'			I	II
know	'I know where you're hiding!' 'Do you know whose house this is?'		I	I	I
remember	'Hmm, I can't remember that.' 'Can you remember where it is?'	I		I	I
pretend	'It's ok, I'm just pretending to be sad!' 'Can you pretend to be a mouse?'	I		I	I
tired	'I'm so tired, is it bedtime yet?!' 'Are you tired?'				III
worried	'Is she worried she will be late for school?'	I	II		
sad	'Why are you sad?' 'I'm sad because I banged my toe.'			III	
frightened	'The little mouse was frightened of the snake'.	I		II	

Table 120. Group 2 Mental state vocabulary questionnaire responses, N=3

target word	examples	Never	Once a month	Once a week	Daily
think	'I think it's here.' 'Where do you think it goes?'		I	I	IIIIIIIIII
like	'I really like this song.' 'Do you like bananas?'				IIIIIIIIIII I
want	'I want you to go in there.' 'Do you want a drink?'				IIIIIIIIIII I
play	'I'd like to play with this.' 'What are you playing?'			I	IIIIIIIIIII
know	'I know where you're hiding!' 'Do you know whose house this is?'			II	IIIIIIIIII
remember	'Hmm, I can't remember that.' 'Can you remember where it is?'	I		IIIII	IIIIII
pretend	'It's ok, I'm just pretending to be sad!'	I	I	IIIIII	IIII

	'Can you pretend to be a mouse?'				
tired	'I'm so tired, is it bedtime yet?!' 'Are you tired?'			II	IIIIIIIII
worried	'Is she worried she will be late for school?'	III	II	IIIII	I
sad	'Why are you sad?' 'I'm sad because I banged my toe.'			IIIIIII	IIII
frightened	'The little mouse was frightened of the snake'.	I	IIIII	IIIII	I

Table 121. Group 3 Mental state vocabulary questionnaire responses, N=12

Whilst these snapshots do not give a fully rounded picture of the parents use of language with their child, it is possible to see that in all groups (considering that group 2 only had 3 responses) there is daily or weekly use of simple mental state terms such as 'think', 'like', 'want' and 'know'. In group 1 'remember' and 'pretend' are used less frequently but by group 3 this had increased. The least used words were 'worried' 'sad' (group 1) and 'frightened', suggesting a similar pattern to the lack of negative state words in the Tingley et al. (1994) study. Overall the parents in this study used a variety of mental state terms with their children on a daily or weekly basis and this pattern does not appear to change markedly with the ages of the children.

10.4 BPVS

As discussed throughout, the inclusion of the BPVS in the testing and analysis of this study was contentious. It was understood from the outset that the BPVS may not adequately capture the children's comprehension levels. On administering the tests the researcher felt that the children were not always showing their true ability and this was confirmed by the comments of the teaching assistants and parents who were present at the sessions. As can be seen in Table 122 the adult who was present at the session was given the opportunity (in the feedback questionnaire, Appendix 4) to comment on how effectively they thought the BPVS captured the child's receptive vocabulary. They were given space to write an open comment about how they felt the child responded to the test.

Author	Comment
Teaching assistant	"The child appeared to be pointing to a picture even as the word was said – anticipation, recognition of a familiar picture? Did see some evidence of self-correction."

Teaching assistant	"Great focus to begin with but half way through a picture triggered thoughts and to contribute info verbally giving more detail. Then figetty."
Parent	"Fabian's attention reduced as the task progressed and he got some wrong which he knows. There were one or two that he knows but didn't point to. Sometimes impulsively pointed to the first picture he focussed on."
Parent	"Answered most accurately to her knowledge. Only a few I would say she knows at home but got wrong (1 or 2)."
Teaching assistant	"Felt slightly that didn't always do the child justice as to their capacity and potential. Interesting as sometimes felt child knew certain things but it appears the child did not."
Teaching assistant	"Watched with interest at how some of the vocabulary used was quite difficult but Scarlett got some of the trickier ones correct."
Teaching assistant	"The picture scales were appealing to Misha. She enjoys showing off her vocab knowledge. She turned off the task when they became more difficult and she began to get a few wrong. Maybe some more simpler words mixed in may have kept her going for longer."
Teaching assistant	"Anna did enjoy this, however she did get a little unsettled after a while."
Parent	"Gets bored quickly then gets words wrong on purpose."
Teaching assistant	"Ruth is very eager to please and sometimes points at the wrong picture bit then thought about it and changed her answer – good to see."
Teaching assistant	"Some right/wrong that I didn't expect – noticed often chose bottom left of picture when unsure (Thomas left handed)."

Table 122. Group 2 and 3 Parents' and teaching assistants' responses to the BPVS

Many parents and teaching assistants ticked the boxes 'Knew more words than I expected' *and* 'Got word wrong which I think he/she knows' indicating that the child's performance was inconsistent and potentially unreliable, as has also been suggested in the raw score data. As seen in the group 2 and group 3 analyses, the BPVS data does not clearly relate to any other factors in this study, for example pass and fail rates or off task behaviours. Along with the inconsistent pointing evidence that was seen in the group 3 case series analysis, the data evidence from the BPVS must be treated as an incomplete and potentially unreliable picture of the children's language comprehension ability.

Chapter 11: Whole study findings and discussion

This chapter brings together the three discussions from the individual group analyses. The developmental trajectories outlined in earlier chapters are synthesised to map out firstly the behavioural changes observed across the groups, and then to suggest what cognitive changes may be taking place to create those behavioural changes.

Through individual group analysis developments in the children's behaviour, which are potentially underpinned by cognitive changes, have been described. To try and bring this information together is a complex task. In order to synthesise the analysis from all three groups, firstly behavioural and then cognitive changes will be described. Finally the two areas will be synthesised to describe a possible trajectory for the whole group's development of theory of mind skills.

The behavioural change description will show how particular behaviours persisted throughout the different age groups and describe how some were restricted to particular groups. How cognitive changes may constrain or allow conceptual change across the whole group will be explored and by drawing together these two descriptions a development of theory of mind for individuals with Down's syndrome will be described. In Chapter 12 this development is discussed in terms of the educational implications and the support of individuals with Down's syndrome.

Before the whole study findings are considered, comparisons with typically developing groups must be discussed. Although reference has been made throughout this thesis to when typically developing children reach particular milestones or develop skills, it has been done with the note of caution raised in Chapter 2. It would be possible to compare the trajectory described below with that of typically developing children and indeed such comparisons may produce some interesting discussion points. However as suggested earlier such comparisons may encourage the ‘delay or deviance’ debate which pits ‘normal’ against ‘not normal’ and forgoes the right of those with developmental disabilities to have a ‘typical’ trajectory of their own which is as valid as any other. In terms of comparing the trajectory being described to that of typically developing children there are two specific points to consider;

1. Although what is being described *behaviourally* appears to proceed in a similar manner to a typical trajectory there are important underlying cognitive differences which individuals with Down’s syndrome must work with in order to reach a similar end point. According to a neuroconstructivist approach, small differences in the brain at birth may mean that the ‘route’ a child with Down’s syndrome may take to develop a skill may be very different to that of a typical child.
2. The development described here covers 7 years (ages 2 to 9 years). A typical time frame for theory of mind development is between 3 and 4 years (between the ages of 1 – 5 years). This would seem to suggest that individuals with Down’s syndrome do indeed have developmental delay, working at roughly ½ their chronological age. However as can be seen in the descriptions that follow, constraints placed on cognitive development mean that whilst it may appear that individuals with Down’s syndrome have merely *delayed* functions, underlying that delay may be different processes and routes of progression to the same end point.

11.1 Behavioural developments seen across the whole cohort

Seen at ages	Joint attention		Imitation	Off task behaviours				Pretend play/symbolic play		TOM/ social understanding
	Gaze switching	Pointing/ directing		Refusing task – no response	Refusing task – physical means	Refusing task – self-directed play	Refusing task – redirecting researcher	Pretend play	Symbolic play	
2-3 4-5 6-9	no gaze switching	pointing at an image	imitation of practical aspects of task	looking away/ avoiding the task	walking away from task					
2-3 4-5	gaze switching which doesn't help task	pointing to distract partner without checking	imitation of social aspects of tasks		throwing/ pushing toys away					people are separate than me
4-5						using toys to create self-directed play	engaging researcher in play	following simple script sequences	uses object for what they are	
4-5 6-9	gaze switching to check for answers	pointing to distract partner with checking			tidying toys away to end task	using toys appropriately but for different outcome	engaging researcher through sign/speech	small world play – dolls as objects in own right		people as possessors of things (ownership) and people as doers

										(biological entities)
4-5 6-9		pointing to lots of answers or vague - no clarity						following transformation sequences	able to use one object to stand for another	people have different contents in their minds
4-5 6-9								able to embed transformations in own script	able to use one object to stand for a number of things	
6-9	gaze switching on key questions/ moments	pointing to indicate an answer								people as having desires and beliefs
6-9							no off task	small world play – dolls 'stand for' people		people as having false beliefs

Table 123. All groups Description of the behavioural changes observed across the whole cohort (groups 1, 2 and 3) Shaded areas show where the behaviour is not see

Behavioural changes observed across the whole cohort are mapped out in Table 123, which charts the way gaze switching, imitation, off task behaviours and pretend/symbolic play changed in the three groups of children. The first column shows at what ages behaviours were seen and the final column shows how the behaviours seen (or those which were absent) relate to the development of theory of mind. Shaded areas show where a particular behaviour is not seen. From this table a number of interesting points arise.

The behaviours of no gaze switching, imitation of practical aspects of the task, looking away/avoiding the task and walking away from the task were observed in all the age groups. This suggests that these behaviours are not indicative of an entire lack of some conceptual knowledge or cognitive ability, but that they were produced when the children could not access the particular tasks set. Therefore the children in group 3 who produced these behaviours may well have been able to access the tasks from group 2, had they been presented with them. It is important to consider that, just because an 8 year old and a 2 year old produce the same behaviours, it does not mean that they are necessarily cognitively comparable. It may be that the older child relies on old learnt behaviours to reject tasks which are too difficult.

The way children use pointing for more sophisticated means appears to develop at the same time as more purposeful gaze switching. Since both of these behaviours are underpinned by joint attention ability this seems an appropriate alignment. However the time it took for these two behaviours to appear fully functional appears very extended. In fact it was only children in the 6-9 age group (and at the top age range of this group) who used gaze switching to support their learning and accurate pointing to communicate an answer to a question. This may come as a result of slow to develop non-verbal requesting behaviours (Mundy et al., 1988), instrumental requests (Fidler et al., 2005; Kasari et al., 1995) and less declarative pointing (Legerstee & Fisher, 2008) in infancy.

The use of imitation to engage in a task appears to stop in the 4 and 5 year olds. In accordance with prior research on this (Wright et al., 2006) imitation may be used for problem solving in younger children, however there was no evidence of this happening in our older children. That some children were still using imitation at ages 3 and 4 may indicate that they are relying on this skill to tackle tasks they were not cognitively able to address.

Off task behaviours were observed all the way through the age ranges and became increasingly sophisticated in the older age group. Behaviours to avoid tasks have been found in other studies (Pitcairn & Wishart, 1994; Wishart, 1996) and have been linked to task difficulty. It appears in this study that the more the children were finding a task difficult (measured by their task scores) the more likely they were to display off task behaviours. What may be interesting however is that their off task behaviour strategy use appears to develop at the same time as their social understanding. As the children acquire a more developed theory of mind, such as understanding that 'other people are different than me', they are also able to use off task strategies which employ this understanding, redirecting the researcher for example.

In the small group of 4-5 year olds (n=9) pretend play and symbolic play appeared to develop in tandem, there was little difference in the passes and fails for these tasks. Other studies have also suggested a non-linear path in the development of pretend and symbolic play in children with Down's syndrome (Hill & McCune-Nicolich, 1981). However the group in the current study was very small and the results were obtained cross-sectionally, so crucial developments in these two areas either before or after the assessments may have been missed. What is interesting to note is that some children in the 6-9 year old group were displaying pretend play skills by simple small world play but they were also finding the group 3 tasks very difficult and displaying off task behaviours. This would suggest that they were not at a developmental stage to pass the false belief tasks but could have been successful if group 2 tasks had been administered.

The final column in Table 123, which tracks how the social and theory of mind skills are changing across all three groups, shows a development similar to that which would be seen in typically developing children (Amsterlaw & Wellman, 2006; Flynn et al., 2004). The children in the current study appear to be able to use their developing skills to approach the tasks set with an increasing understanding of others, however it must be stressed that even in the oldest group it appeared that this understanding was still very fragile.

A key aspect of behaviour which is missing from this analysis is that of expressive language. Whilst language comprehension is implicit in the children's responses to the tasks, the expressive language of the children was rarely seen. In fact the most expression was seen in off task behaviours when the children used sign and speech to redirect the researcher. The children did not use very much expressive speech in the tasks, and used little outside, but this absence may be important. That the children would engage the researcher when the topic was of interest to them (when they were off task) could indicate that the children's working memory is working at full capacity during the tasks and they have no 'space' to create spoken language. When the children are off task they do not have to follow someone else's thoughts or actions and therefore may have capacity to generate speech. Furthermore there is a social imperative to engage in speech which moves situation onto a topic which is familiar. These are issues which could certainly be the basis of an interesting further study.

11.2 Cognitive developments seen across the whole cohort

Implicated at ages	Prior knowledge	Working memory	Executive functions	Representational ability	TOM/social understanding
2-3 4-5 6-9	Schema for 'objects existence even when they are not observable' Performance or imitation = praise	Able to use sequential spatial working memory to support task demands	Concurrent processing and storage not efficient Inhibitory control not controlling physical actions on toys	Empirical representations which are tethered to the present No ability to call up previous representations Representation fixed to domain	
2-3 4-5	Emotional schema for correct/incorrect performance Schemas in development for physical properties of objects No pretend play schemas	Simultaneous spatial working memory inefficient - so unable to represent 2 spatial possibilities		Level I (implicit) representation Empirical representations fixed to observable events and objects	
2-3 4-5	Goal schema in development Play schemas more prepotent than task requirements		Inhibitory control not efficient and lets play schema overwrite task requirements	Hypothetical representations beginning to be formed—allowing for goal detection	people are separate than me

2-3 4-5	Goal schema established Communication as a 2 way device				
6-9	Play schemas limited to dolls as objects rather than symbols Simple ownership schema (things belonging together)	Phonological loop difficulties preventing access to task			
4-5	Underlying pretend play schemas are just developing but not consistently applied Short script sequences evident in pretend play	Phonological loop prevents clear representation of sequences	Concurrent processing and storage made more difficult by weak pretend play schemas	Representation not able to support longer play sequences—because of weak pretend play schemas? Able to represent entities which are not there	people as possessors of things (ownership) and people as doers (biological entities)
4-5	Pretend play schemas are developing through trial and error		Inhibitory control developing enough to control distractions outside of task	Dual representation allows pretend play and allows for objects to be renamed in play	
4-5	Pretend play schemas in place Others as intentional agents developing		Inhibitory control is able to control external distractions, but not internal—the stick *is* a pencil	Representations at level E1, elements able to be shared across domains	people have different contents in their minds

				Representations allow following of story line	
6-9	Time schema in place Belief/desire schema developing? Dolls as symbols developing	Storage capacity able to retain story but cannot concurrently store and process	In task inhibitory control unable to prevent prepotent response (salience)	Undergoing representational change to be able to use information from a number of domains	people as having desires and beliefs
6-9	Belief/desire schema in place False belief schema emerging	WM is able to store the detail of the story	Able to supress prepotent response Simultaneous spatial WM unable to process false		
6-9	False belief schema developing A number of schemas in use at one time		Executive control developed enough to allow for concurrent processing and storage	Meta representation allows flexible thinking across domains	people as having false beliefs

Table 124. All groups Description of the possible cognitive developments underlying the behavioural changes observed across the whole cohort (groups 1, 2 and 3)

The possible cognitive changes that are outlined in Table 124 are necessarily much more speculative than the behavioural changes which could be readily observed. The suggested cognitive changes are drawn from the knowledge the children appeared to show during their assessments, prior research on the cognitive development of children with Down's syndrome and theoretical explanations of the development of representation in typically developing children. In charting the changes across the three groups it is possible to suggest a continuum of cognitive development which doesn't seem apparent when examining each group individually but, as the data is not longitudinal, is equally not a clear trajectory.

In Table 124 the children's prior knowledge appears to develop through small changes in understanding which may be mediated by the more overarching understanding of theory of mind. The figure shows that many changes were seen in the conceptual development that the children brought to the task, but far fewer changes in theory of mind development. This may suggest that, whilst prior knowledge is formed into topic and action schemas on an ongoing basis, constantly changing the child's knowledge base, theory of mind developments are slower to construct and change.

In the first row of Table 124 there is an age overlap, suggesting that children from any of the age groups may show evidence of working at this level. However, taken with the similar caution as the behavioural changes above, it may be that the children were displaying these types of cognitive abilities as their response to tasks which were too difficult. Similarly, they may well have had cognitive abilities above those displayed, but our tests did not capture them.

Quite how working memory and executive functions affected this cohort is very difficult to assess using the chosen methodology. There is some evidence in the way children responded to the tasks, for example being unable to supress a prepotent response, which suggests that executive functions played a part in the way behaviours manifested. It is suggested here that working memory and executive functions may allow or constrain development of other areas, however it is also possible that prior knowledge or representational ability constrain working memory and executive function in a similar way. The known difficulties with concurrent processing and storage (Carney et al., 2013), inhibitory control (Borella et al., 2013), the phonological loop system (Jarrold, Baddeley, & Phillips, 1999) and spatial working memory (Lanfranchi, Jerman, et al., 2009) may all contribute to the way in which schemas and representations are developed.

The challenges that difficulties in working memory and executive function present may necessitate children finding alternative ways to support their knowledge generation. For example Beeghly and Cicchetti (1987) suggested that children with Down's syndrome show much more repetition in their play. It may be that this is needed to overcome working memory limitations. Similarly Wright et al. (2006) suggest that children with Down's syndrome use imitation in order to tackle tasks. It could be suggested that this strategy is used in order to facilitate learning; if the child can use imitation rather than having to commit a sequence to an inefficient working memory then they may be able to reach the solution by bypassing the working memory aspect of the task. This would facilitate learning the end point of a task, and afterwards being able to use freed up working memory (because the task outcome is already known) to work out the task process. At this stage this is conjecture, but it may be an important avenue to pursue in further research if we are to understand the learning processes of individuals with Down's syndrome.

11.3 Analysis and Discussion Summary

From this study it can be suggested that children with Down's syndrome follow a trajectory in the development of their theory of mind which begins with an understanding that people are separate from oneself, develops into an idea that people can 'possess' and can 'do', progresses to an understanding of other people as having minds and eventually this develops into a belief/desire and then false belief understanding. There may also be many points of development in between these stages which this study was not sensitive enough to capture and which may show a subtler and a perhaps less linear course of development.

These changes in theory of mind appear to happen through a development of representational ability which is supported by a reciprocal relationship with the prior knowledge of the child. Representational change and knowledge acquisition are mediated by the working memory and executive functions, which work in a distinctive way in individuals with Down's syndrome.

The sequence of theory of mind development is protracted and is still not secure at the age of 8 or 9 years old. Children may not secure skills along this trajectory quickly; this study noted children of different ages using the same strategies to approach or reject tasks. This suggests that children with Down's syndrome need much more practice to consolidate their skills and to secure their prior knowledge.

Off task behaviours were informative in this study about children's ability to use their developing theory of mind. That they were able to use ever more sophisticated means to redirect the task and it is suggested that, although they may not be able to use their developing skills in formal tasks, they were practicing using their skills in social situations and at points where they were able to direct the communication.

These social abilities appeared to develop at a similar time to the children's understanding of intentional communication, which took take a long time to become well embedded in children's behaviour. Although the children in this study were able to show their developing theory of mind skills at different stages, it was rare that this was homogenous across groups or that behaviours were only observed at one age range. What this suggests is that not all 6 year olds, for example, with Down's syndrome will have developed the same set of theory of mind skills, an essential consideration in a school setting.

How these results may impact on children's education and learning is an important consideration. If children with Down's syndrome are entering school without secure theory of mind skills, this may prevent them from learning in a number of key areas.

Chapter 12: Impact and application

12.1 Educational impact

Many children with Down's syndrome now have access to mainstream primary schooling (Cuckle, 1997)[6] and are expected to start school at age 4 or 5 along with their typically developing peers. Children with Down's syndrome grow up with the same psychological and physical needs as any other child and develop into teenagers who have the same aspirations as their typically developing peers (Cuckle & Wilson, 2002). As such it is important that children with Down's syndrome are educated with their peers and that age appropriate interests and needs are nurtured. Whilst research suggests that mainstream schooling for individuals with Down's syndrome is important in academic terms (Buckley, Bird, & Sacks, 2006; Casey, Jones, Kugler, & Watkins, 1988; Cunningham, Glenn, Lorenz, Cuckle, & Shepperdson, 1998), it may be less positive in terms of social development and quality of friendships (Cuckle & Wilson, 2002).

Successive governments have placed a focus on the child's 'school readiness'. Current Early Years guidance suggests that the Early Years Foundation Stage "*promotes teaching and learning to ensure children's 'school readiness' and gives children the broad range of knowledge and skills that provide the right foundation for good future progress through school and life". (DfE, 2012, pg. 5).* The issue of school readiness is important when we consider that right across all cohorts in this study children's theory of mind was not well developed. In the group of 4 and 5 years olds (group 2) developing pretend play skills were observed, but in the 6 to 9 year olds theory of mind skills were only just beginning to develop. This may suggest that children with Down's syndrome are not yet 'school ready' in this

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[6] These are the most recent figures collated. Local Authorities are not required to report figures for children with Down syndrome; they are included in SEN figures.

important area at age 4 and 5. This important aspect of their social and emotional understanding may impact on their future success at school:

"Most children begin reception class at age 4, and for most parents and carers this is when school life begins. If children are not ready for this transition or the move to Year 1 because, for example, they are not yet toilet trained, able to listen or get on with other children, then their experiences of school could present difficulties which will obstruct their own learning as well as other children's. The evidence is clear that children who are behind in their development at age 5 are much more likely than their peers to be behind still at age 7, and this can lead to sustained but avoidable underachievement." (Pg 19. Tickell, 2011)

Whilst Tickell is describing the underachievement of typically developing children here, her idea of an 'avoidable outcome' can also be applied to children with Down's syndrome. Whilst we do not know how well theory of mind skills may be encouraged in children with Down's syndrome (and have little evidence in the typically developing population (Flynn et al., 2004; McGregory, Whiten, & Blackburn, 1998)), it is evident from the results of this study that it is a significant area of difference which may affect progress in other areas. Because theory of mind is an essential component of social and emotional development, the implications of not having developed a theory of mind by the time of stating school could be long term:

The associations over time found in this study support the view that children who are especially mature at understanding others in their early preschool years do attempt to negotiate and resolve conflicts in ways that take account of others' views and needs. […] It was how children worked towards resolution—rather than how often they disagreed and quarrelled with their friends—that was linked to their early mindreading abilities, emotion understanding and moral orientation. (Pg 12. Dunn & Herrera, 1997)

What the authors are suggesting here could be important in the findings of the current study; not only will children who begin school with a poor, or absent theory of mind be disadvantaged in their academic success, they may also struggle to negotiate friendships and social activities. Since this is an area which children and adolescents with Down's syndrome find difficult because of speech and language differences, social exclusion and different interests (Cuckle & Wilson, 2002; Sigman & Ruskin, 1999), an underdeveloped theory of mind may only compound these difficulties.

Much of the literature on education of children with Down's syndrome sensibly focusses on literacy and numeracy (Jones et al., 2013) and social understanding in education is rarely discussed in its own right (for an exception see Buckley, Bird, & Sacks, 2002) or comes under a more general 'behaviour' heading (DSA, 2011e). Social understanding is often discussed in peer-relationship terms (Sigman & Ruskin, 1999) but our research suggests that young children with Down's syndrome may be a lacking fundamental foundational knowledge about others' minds which underpins much of what happens in schools.

Theory of mind skills are an essential foundation on which much learning in school is built upon. There is an underlying assumption that reception aged children will have already developed some ability to pretend play, to understand characters' behaviours and emotions in stories and to have early skills in abstract concepts such as number and time. Table 125 shows examples of some of the areas which children are expected to develop in over their reception year, all of which require some understanding of 'the mind' or an understanding of the possibility that things exist which are not directly observable.

Early learning goal	
ELG03	**Speaking:** Children express themselves effectively, showing awareness of *listeners' need*. They use *past, present and future forms* accurately when talking about events that have happened or are to happen in the future. They develop their own narratives and explanations by *connecting ideas* or events.
How theory of mind is implicit in this goal	*Listeners need* suggests an understanding of other's points of view. *Past and future* both rely on a representational ability to imagine these hypothetical and not current situations. *Connecting ideas* suggests the use of purposeful mental activity, thereby needing representational ability and potentially some understanding of one's own meta-cognition.
ELG02	**Understanding:** Children follow instructions involving *several ideas or actions*. They answer *'how' and 'why'* questions about their experiences and in response to stories and events.

How theory of mind is implicit in this goal	To follow *several ideas or actions* one must be able to call up a number of representations at a time *How and why* are theoretical questions which ask for an interpretive answer based on an assumption of psychological understanding (in this instance).
ELG12	**Space, shape and measures:** Children use everyday language to talk about *size, weight, capacity, position, distance, time and money* to compare quantities and objects and to solve problems. They recognise, create and describe patterns. They explore characteristics of everyday objects and shapes and use mathematical language to describe them.
How theory of mind is implicit in this goal	*Size, weight, capacity, position, distance, time and money* are all abstract concepts which require a representation of them to be formed in order to manipulate understanding.
ELG 13	**People and communities:** Children talk about *past and present events* in their own lives and in the lives of family members. They know that *other children don't always enjoy the same things*, and are sensitive to this. They *know about similarities and differences between themselves and others*, and amongst families, communities and traditions.
How theory of mind is implicit in this goal	To imagine *past and present events* a representational ability is needed. Understanding *other children don't always enjoy the same thing* requires at least a basic belief/desire reasoning ability. Knowing about *similarities and differences* between oneself and others requires an understanding that other people have minds.

Table 125. Examples of areas of learning taken from the Early Years Foundation Stage Handbook, my italics (DfE, 2014)

Implicit not only in these goals, but in the language used to describe these goals is a clear assumption that children will be able to use mental processes to grapple with abstract concepts and at some points be aware of their own and other's mental processes. Aside from the fact that children with Down's syndrome may not have the expressive language abilities to express these ideas, our research suggests that children with Down's syndrome aged 4, and most likely until the ages of 7 and 8, are unable to use theory of mind skills to address these kinds of goals.

In year 1 the curriculum becomes more academically focussed, with less emphasis on play centred learning and a more cognitive style of engagement with learning encouraged. In the English curriculum for example, pupils should *"develop a capacity to explain their understanding of books and other reading, and to prepare their ideas before they write. They must be assisted in making their thinking clear to themselves as well as to others and teachers* *should ensure that pupils build secure foundations by using discussion to probe and remedy their misconceptions." (DfE, 2012, p.12)*. The emphasis here is on the children's metacognition, or learning through thinking, rather than learning through doing. For children who are unware of their own, or other's, cognition this shift in emphasis may create a barrier to learning. If children who have not developed a theory of mind are 'moved on' too quickly from being able to explore through role play, pretend play and symbolic play this may slow down the progress of developing their representational theory of mind.

Most children with Down's syndrome in mainstream schools have work differentiated for them and work with support to enable them to access the curriculum to some degree. (Bird, Alton, & Mackinnon, 2000; Miller et al., 2004). Advice on how to differentiate work often considers levels of verbal language, language comprehension, reading ability, working memory and the learning through using physical and visual resources (Bird et al., 2000; DSA, 2011b). There is a focus on teaching children with Down's syndrome to read (Bird & Buckley, 2001; DSA, 2011c) and to be numerate (Bird & Buckley, 2001; DSA, 2011d) in recognition that these life skills are in important element of independent living as an adult. It could be argued that the development of a theory of mind is an equally important skill which enables social and emotional capacity and understanding. A challenge is to consider what aspects of theory of mind may be able to be scaffolded, how they can be supported and what effect this may have on a child's overall development.

The evidence from this study suggests a number of ways the development of theory of mind may vary in children with Down's syndrome. Some of these areas are supported by the good practice and quality first teaching already established in schools, but some will require new ways of working with children.

Areas identified in the whole study findings in Chapter 11 are discussed below in detail, with reference to specific educational situations where the area of variance may be particularly relevant.

12.2 Educational application

Of upmost importance in the development of this study was the concern with how the findings of the study could be utilised by professionals working with children with Down's syndrome. Section 12.4 describes in detail how a lack of theory of mind skills may impact on a child's ability to learn and develop. This section extends this description to outline specific areas of development professionals should identify and indicates what skills may need to be encouraged for the child to reach a next level of theory of mind development. Table 126 also gives suggestions of the types of general support which can be given as well as specific examples of activities.

To consider when accessing the suggestions below is the chronological age of the learners and where they may be in terms of their schooling. Whilst it is easy to suggest how to engage a typically developing child of 18 months in pretend play, as the setting they are in (nursery or pre-school for example) will have the necessary equipment and set up, this may not be so for a child with Down's syndrome aged 4 or 5 in reception or year 1. Schools provide less and less opportunity for natural play based learning as children move through the school years and so opportunities for this type of learning need to be carefully created by practitioners. There is no suggestion here that children should be taken to younger years' classrooms for the activities suggested below, or that they are extracted alone for the activities. Care has been taken in the examples to show how the activities can take place in whole class or small group situations and that the activities are linked to age appropriate whole class work and curriculum themes.

A further consideration when designing activities to develop theory of mind skills is to recognise that theory of mind is a social skill. Activities carried out with one child or between a practitioner and child will not give much opportunity for social learning through mimicry, observation or practice. Although the activities below are manufactured situations they should be made as social as possible, ensuring that natural learning about social cognition, as well as the more formal learning, can take place.

Theory of Mind Key Area: Joint attention – gaze switching

Practitioner observation of child's skills:		Unable to purposefully switch gaze	Gaze switching doesn't help with tasks	Switches gaze to adult to check answers
What we need to do:		Help the child to actively switch their gaze between objects/people	Help the child to recognise that looking between objects/people can give us useful information	Help the child to ensure the adult knows they are requesting attention
General strategies		When playing gaze switching games ensure items are all similar distance away to avoid re-focussing issues Take clear turns when talking to the child – wait for them to switch gaze, say their name to help them know to look at you (Example 1)	Give clear instructions to the child about when looking will help. (Example 2)	Make explicit reference to when the child is looking at you, 'You want me to see the car?', 'Good looking.' Encourage gaze switching with others; 'Can you show Sarah the car?'
Examples of specific targeted activities: (Nursery/reception classroom)	1	2 practitioners work together to model looking behaviour. Play a ball game rolling the ball between members of the group, before each roll say the recipient's name and wait for eye contact.		
	2	Children and practitioners play a ball game together in which the ball has to be rolled to a choice of 2 images. Each child is given a picture card and they have to roll the ball to the matching card. This will encourage the child to look between the cards to see the match.		
	3	Children and practitioners work together to complete a series of activities which are slightly too difficult for the child (unscrewing a jar for example). When the children need help the practitioner waits for eye contact before helping. This can be made more complex by the practitioner purposefully looking away so the children have to work hard to get her attention – either by vocalising or by touch.		

Theory of Mind Key Area: Joint attention (pointing)

Practitioner observation of child's skills:		Points to distract or request, without eye contact checking	Points to distract or request, with eye contact checking	Points to indicate an answer but vague/lots of different pointing	Points to indicate an answer – sticks to one answer
What we need to do:		Help the child to develop gaze switching strategies along with pointing	Develop the child's understanding of pointing to label and show knowledge – using sign and speech	Develop the child's ability to say they don't know/ask for help. Develop the child's understanding of pointing to label and show knowledge	Develop support for pointing – using speech or sign to show understanding/develop answer
General strategies		Ensure staff don't respond to pointing without gaze – particularly in requesting Label items for child verbally and with sign – encourage copying Model using pointing with checking gaze (Example 1)	When child makes eye contact label items for child verbally and with sign – encourage copying. (Example 2)	Allow the child's answer but help to narrow down how specific the child's pointing is. (Example 3)	Allow the child to point to show answer but develop answers by giving more options. (Example 4) Encourage child to label verbally and with sign.
Examples of specific targeted activities: (Nursery/reception classroom)	1	Find 5 farm animals the child knows the verbal labels for. Let the child watch you put them within an easy visual distance around the child but out of reach. You are going to make a farm, but you need to find the animals. Ask 'Where's the dog?'. Practitioner occasionally points to the wrong item. Encourage the child to follow your gaze from the object to each other and back again. Watch for signs that the child knows you have pointed to the wrong object. Encourage child to show you the correct answer ('Oh, isn't that the dog? Where's the dog then?). In this game you are modelling using gaze and pointing to check that you are both sharing the same referent.			
	2	2 practitioners work together alongside the child. Outside in the mud kitchen the child and practitioners play. Practitioner 1 points to a spoon, looks to practitioner 2. Practitioner 1 labels the spoon 'Do you want the spoon?' Practitioner 2 models response 'Spoon please', whilst still pointing. This kind of exchange can happen a number of times within a play session to reinforce for the child how to verbalise/sign a label.			

	3	A small group are singing '5 currant buns in a baker's shop'. They have a number of props; they take it in turns to wear the baker's hat and to be the boy/girl with the penny. The practitioner asks Jack, who has Down's syndrome, which bun he would like. He points to all of them in turn. The practitioner responds with speech and sign, 'Oh you would like all of them? Well, let's choose one for now – can you point to the red bun?' Jack points in a vague motion towards the buns. Practitioner: 'Let's try and point to the red bun'. He asks the children to point to the red bun, including Jack. On Jack's turn, if needed, the practitioner can pick up the bun and move it towards Jack to help him point specifically at the red bun. After Jack has pointed the practitioner can reinforce 'You pointed at the red bun Jack, so you can have the red bun'.
	4	In the music corner the children have a range of instruments out. The practitioner has picture cards with pictures of the instruments on, with 'sound' words and illustrations (loud/quiet, tinkle/boom, hard/soft etc.) and ways to play (blow, hit, bang, tap, strum). The children can choose 2 cards by using pointing, speech and sign. So they may choose 'loud' and 'blow' – then they can discuss which instrument might make a loud noise when you blow it (and then of course have a go on the instrument). This will enable the child with Down's syndrome to choose from a range of options by using pointing, and their choice making is reinforced by speech, sound and by playing the instrument they choose.

Theory of Mind Key Area: Pretend play skills

<table>
<tr><td colspan="2">Practitioner observation of child's skills:</td><td>Child can follow/copy the practical aspects of the play sequence (for example, holding a cup to toy's mouth)</td><td>The child can follow the pretence when something unexpected happens but may not be able to change their play</td><td>The child can embed and anticipate unexpected sequences and incorporate them into their play</td><td>Toys can 'stand for' people and have likes/dislikes/needs and feelings</td></tr>
<tr><td colspan="2">What we need to do:</td><td>Develop the child's understanding that the sequence is a 'pretend' version of real life situations</td><td>Develop the child's flexibility in pretend play, focussing on incorporating new information</td><td>Engage the child's understanding that unexpected events affect not just the play sequence but the 'psychological' life of the toys</td><td>Develop the child's understanding that we have different responses and contexts to events</td></tr>
<tr><td colspan="2">General strategies</td><td>Use free play to practice the practical elements of pretend play: stirring, building, drinking
Practitioners to use explicit mental state vocabulary 'I'm pretending that…, 'It's not real.' (Example 1)</td><td>Ensure the child has lots of time to process before moving the play on, if necessary ask other children to wait.
Practitioner to suggest simple disruptions in pretence. (Example 2)</td><td>Use key 'feelings' words to describe the toys; 'Is Spiderman happy his chocolate cake is on the floor?'
'Oh, Elsa thought we were going to the beach, but now we're going shopping? How does she feel?' (Example 3)</td><td>Use contrasts to highlight differences; 'I'm going to paint purple, because that's my favourite, but teddy likes green best'.
'The grass is out of bounds today because it's wet. I don't like the grass so I'm happy. What about you?'
(Example 4)</td></tr>
<tr><td>Examples of specific targeted activities:
(Year 1/2 classroom)</td><td>1</td><td colspan="4">At snack time the practitioner suggests that the class icon (a toy) also joins in snack. In a small group the children take it in turns to give the toy some snack/drink and are encouraged to say what they are pretending to do. This could be extended to suggest whether the toy likes/dislikes the snack/drink.</td></tr>
</table>

	2	The class project is about pirates. The children have constructed a pirate ship in the corner of the classroom, the practitioner is supporting them in pretending to scrub the decks, climb the rigging etc. S/he introduces the idea of a storm and prompts the children in deciding what they might need to do in their pretence to incorporate this new information.
	3	Practitioner and children work together to create social stories about key people and events from current topics. Using IT resources such as stop-frame animation the child can create a story, add in an unexpected event and then show how the character might feel about it.
	4	Practitioner and children work collaboratively to make likes/dislikes charts and diagrams. For other students in the class this can form part of their maths curriculum, developing tally charts and pie diagrams. For the children developing their understanding of theory of mind this can be focussed on examining the differences in people's opinions. The child can take photographs of the other children in the class (and the class icons) and place them on a chart to show what they like or dislike.

Theory of Mind Key Area: Symbolic play

Practitioner observation of child's skills:	Child uses objects/props for what they are	Child can use an object to stand for another thing	Child can use an object to stand for more than one thing	
What we need to do:	Encourage child to use imaginative skills to allow objects to be transformed	Develop the child's ability to be flexible in their symbolic thinking	Develop the child's ability to become more abstract – imagination not tied to objects	
General strategies	Use terminology which encourages the child to see similarities 'It's like a…' 'It could be a…' (Example 1)	Offer alternatives for the child when discussing what objects are like. (Example 2)	Use explicit mental state terms to describe what we 'see' in our mind when imagining. For example 'I imagine…', 'I think…', 'In my mind I see…' (Example 3)	

Examples of specific targeted activities: (Year 1/2 classroom)	1	Practitioner and child work together to create imaginary scenarios for a toy (or class icon). For example, Elsa needs a horse to ride, what can we use for a horse?' Practitioner can carefully choose a variety of props which are able to be transformed into the suggestions (for example a cushion for the horse). At this stage making the props distinct from one another may help the child to symbolically transform them.
	2	Big box game. Practitioner and group of children have a large cardboard box and a number of other props (fabric, tubes, hoops etc). The children work together to transform the box into a variety of different objects. They may take turns to suggest what the box will become, or the practitioner could give them cards with suggestions on to choose from. This activity could be linked to a curriculum theme such as 'transport' or 'where people live'. The children can take pictures of the transformations and then create a book describing what they were pretending.
	3	Use a key 'journey' text such as 'We're going on a bear hunt' to frame an imaginative journey around the school. The children can take it in turns to lead a part of the journey, describing what they can see and acting out the journey, the rest of the group follow and join in acting out the story. The practitioner can encourage imaginative detail which moves away from the text of the book ('Look, there's a fish', whilst wading through the river).

Theory of Mind Key Area: False belief/theory of mind

Practitioner observation of child's skills:		Child is aware that people are individuals	Child is aware that people are possessors of objects and can complete actions	Child is aware that people have different contents in their minds (different knowledge and thoughts)	Child is aware that people have beliefs and desires
What we need to do:		Develop the child's understanding of ownership and individuality	Develop the child's understanding of 'the mind' and that different people have different knowledge	Develop the child's understanding that people can believe something to be true, that they have desires which make them act in certain ways	Develop the child's understanding that sometimes there is a discrepancy between belief and reality
General strategies		Use naturalistic situations to talk about difference, compare and contrast children's lives. Be explicit with contrastive language; 'Ben doesn't have any pets, but Shreela has a cat.' (Example 1)	Use explicit mental state and metacognitive terminology 'I am thinking', 'Do you know?', 'What do you think?' (Example 2)	Use naturalistic conversation to discuss people's actions; 'Tyler is upset, I think she wanted the same pencil as you', 'Jack has gone out because he wanted to get that book'. (Example 3)	Make explicit the contrast between belief and reality 'Jack thought the book was out there, but it wasn't'. (Example 4)
Examples of specific targeted activities: (Year 3/4 class)	1	Practitioner and children design character cards (or use dolls if appropriate). Each character is given a set of likes, dislikes, ownerships and activities (see example below) from a set of predefined choices. Children take turns to turn over a card in the middle which relates to the attributes. If their character has that attribute they keep the card, if not they have to ask the other players if their character has that attribute, and then give the card to them. This activity could be based on a class book or topic.			
	2	Practitioner gives children cards with pictures on (fruit for example). Children have the pictures face up. They are asked to think about the picture on the card, and then to guess what the other children are thinking about. Discuss how we know what they are thinking. Play the game again but this time the children do not let anyone else see their card. Can they guess what the other people are thinking? Why not?			

	3	In groups the children act out short scenarios which are given out by the practitioner. For example: The boy has a ball, him and his friend put it in the cupboard. The girl is going swimming, with her dad she packs her swimsuit in her bag. Children and practitioners talk about how the characters know where the ball/swimsuit is. Discuss if anyone else knows it's there? Discuss what might happen if someone moved it.
	4	As a follow on from activity 3, the scenarios are extended; the boy puts his ball in the cupboard and goes out. His friend comes in and moves it. The girl packs her swim suit and goes out. Her mum and dad decide the family will go to the farm instead and so put her wellies in her bag instead. Discuss what the characters will think when they come back. Where will the boy think his ball is? What will the girl think is in her bag? The practitioner will need to be explicit in their description of why the characters held a false belief. This activity can be recorded to watch back, or photographed to make books to be read again. The number of possible scenarios is endless and so the activity can be completed many times.

Table 126 Suggestions of educational activities

12.3 Extension of this study to other groups of learners

Whilst it has been made clear that a whole class approach to these teaching suggestions would potentially benefit many children in the class, there are specific groups of learners who may find a change in focus particularly beneficial. Deaf children (Peterson & Siegal, 1999; Peterson & Siegal, 2006; Woolfe et al., 2002) and those with an autistic spectrum condition (Baron-Cohen et al., 1985; Peterson et al., 2013) have been shown to develop theory of mind skills later than typically developing children or not at all. The suggestions made above may specifically support the development of theory of mind skills in these groups. Other children may arrive at school without having had opportunities to develop their theory of mind skills because of, for example, maltreatment (O'Reilly & Peterson, 2015), non-specific learning difficulties (Bauminger & Kimhi-Kind, 2008; Kavale & Forness, 1996) or speech and language difficulties (Marton, Abramoff, & Rosenzweig, 2005). All these groups may benefit from initial assessment of and subsequent support in developing their theory of mind abilities. Children with poor reading comprehension skills share some similarities in cognitive profile with children with Down's syndrome in that their verbal profile is weaker than non-verbal (Nation, Clarke, & Snowling, 2002) and working memory may be implicated in their difficulty with comprehension (Carretti, Cornoldi, De Beni, & Romanò, 2005). It may be that some of the areas of variance seen in our study are replicated in this group of 'poor comprehenders' and so the teaching and learning suggestions may also aid theory of mind development in this group.

The implications for this study could be far reaching if, as is suggested, theory of mind skills are assessed when children first start school and these assessments are used to support and develop children's social cognition. Considering the groups discussed above the number of children needing support in this area could far outweigh those with numeracy or literacy difficulties. Specifically supporting the development of social cognition in the early years may improve children's ability to think abstractly and use their representational ability in other subjects; supporting early social cognition may help the core academic practices of numeracy and literacy.

Chapter 13: Limitations and further research

13.1 Limitations and recommendations

As with any study there are limitations and drawbacks from the way this research was conducted. Getting the assessment situation right for the children meant the data collection was not as tightly controlled as would be expected in a more experimental study. Although there was an aim for consistency, the use of questions and interaction with the children was not consistent across groups because a prime aim was to make the participants comfortable and happy to attempt the tasks. Additionally, because the session was stopped when the child indicated there is some incomplete data.

A larger cohort of children, particularly in the middle age group where the dropout rate meant there were less participants (mostly because of difficulties contacting and arranging with schools) may have given greater quantitative data power. It may also have prevented some of the ceiling scores seen in group 2, where the age range was limited. Increasing the age range to include some older participants would have enabled examination of how consistent passing the false belief task is at older ages.

A major limitation of this study is it's cross sectional nature. Ideally this would have been a longitudinal study which followed a cohort of children over 7 or more years to examine how each child developed in the area of social cognition and theory of mind. However time and financial restraints were such that this was not possible.

13.2 Further research

There are a number of routes which this work could now to take in order to validate the results and extend the findings. Firstly this study needs to be replicated, ideally as a longitudinal study following a cohort of children across a number of years. However funding for longitudinal research is costly and in the current funding climate, difficult to obtain. It is suggested that, given the wide range of research there is on infants with Down's syndrome a longitudinal study should focus on children in their pre-school and primary school years. Longitudinal studies of individuals with Down's syndrome are rare, with notable exceptions of Janet Carr's study of 6 week to 4 year olds who were then followed up at 21 years (Carr, 2012), the work at the Hester Adrian Research Centre, University of Manchester (Cunningham, 1986) and a number of more recent studies carried out by Down Syndrome Education International (Byrne, Buckley, MacDonald, & Bird, 1995; Byrne, MacDonald, & Buckley, 2002).

A longitudinal study would allow for a number of distinctive features which were seen in the results of this study being tracked over time. A limitation of the current work is that links between certain skills at different ages are hypothesised; these links need to be tested using longitudinal evidence. A particular benefit of a longitudinal study would be to examine the development of children similar to those in our study who were unable to access the tasks we set. The only conclusion drawn in the current study about these children's skills is that they were not able to complete the tasks, however it is impossible to suggest how they may have gone on to develop their skills or whether they would have been able to pass tasks administered to a different group or in different ways. It is particularly important that these children are included in further research because they form part of the heterogeneous group of 'children with Down's syndrome'. Without their data the group become more homogenous and less reflective of reality.

An important part of this research has been to suggest not just that the findings will have an impact on the education of children with Down's syndrome, but also to offer practical suggestions as to how the findings of this study could be used within educational settings. The suggestions are untested and are based on the researcher's experience as a teacher. An obvious next stage would be to test them out in context to determine their efficacy and practicality in administration. An interesting and important project would be to work closely with teachers and teaching assistants to develop the ideas into workable classroom changes and to follow the progress of children's development of theory of mind across a school year. A study such as this could include other groups of learners, such as those suggested in Chapter 12 to determine whether the changes in classroom practice would also aid their learning in social cognition and theory of mind areas.

A further interesting piece of work would be to replicate the work of Flynn, 2006 and Flynn et al., 2004 using a microgenetic model of developing theory of mind skills. In their studies with typically developing children they showed that some children make some progress in this area with explicit teaching. It would be interesting to determine whether this could also be the case with children with Down's syndrome and some of the other groups identified in Chapter 12.

This study was barely able to touch on the way that language learning and use impacts on the development of theory of mind (or/and vice versa). As this is such an important connection a longitudinal piece of research examining these connections in children with Down's syndrome could make an interesting contribution to the literature. It is important to know, specifically for this group of children, how the relationships between language and theory of mind may restrict or enable growth in social cognition and how this may also be tied up with the way parents, carers and those working with children use language around them. A study examining this could have a major impact on the understanding of how theory of mind develops in children with Down's syndrome.

Since this study was an exploration in the appropriateness of testing techniques and focussed on an under researched area in children with Down's syndrome, it opens up a vast area for further research. This research has raised many more questions than it has answered and offers the research community a number of areas to develop work on. In any work following on from this study it is hoped that the heart of this work remains in focus; finding innovative and child centred ways to help all children tell us, as researchers, what they know and how they came to know it.

Chapter 14: Conclusions

As I stated in the opening remarks of this paper, my primary aim in this piece of research was to have at its core the people whom it concerns. From the initial interest in early development, to the much wider final remit of theory of mind development I have tried to ensure that my thinking and decision making was person centred. A task no doubt made much easier by my daughter serving as a daily reminder of why I am doing this.

Taking a person centred approach has led to difficulties; it is hard to devise tasks which on the one hand focus on the child but also manage to extract the key piece of information needed for analysis. Children (people) are unpredictable and to be person centred research must 'go with' this unpredictably and in the hope that it may produce some interesting data in its own right, no matter how far off the experimental course it is (which of course, it did). Person centred research meant that all of the participants were included in the analysis and the results of those children who were unable to access the tasks were not ignored.

The results of this study show that children with Down's syndrome do develop social cognition skills and that these probably will result in a 'theory of mind'. The time scale of development is slow and the children appear to take a long time firstly to be able to consolidate their knowledge and then to be able to generalise their knowledge. Theory of mind skills were seen earlier in naturalistic situations where the child had some element of control, than in the experimental conditions. Questioning did not help children to express their knowledge or encourage them in conversation; they were most communicative in situations where they could speak or sign about their own interests. I hypothesise that developments in theory of mind are constrained by working memory and executive functions, specifically concurrent processing and storage and the simultaneous spatial working memory. Knowledge schemas co-occur with the development of representations, whether there is a relationship between the two and how this relationship may work needs further research.

I have suggested that using a neuroconstructivist approach will help to answer some of the questions about why children with Down's syndrome develop the way they do, and indeed this framework has been useful in its construction of the way representations are redescribed. There is capacity for this framework to be used in a much more detailed way than there has been space for here, which may help in understanding the process of change in theory of mind skills and how the trajectory is linked to other functions, such as working memory. Neuroconstructivism may encourage research which focusses on individual abilities and could help to change the discourse of deviance or delay.

Staying on track with the commitment to advocating a particular description of the way children with Down's syndrome may develop a theory of mind has also had its challenges. Nearly every article and book read has engaged in the discourse of typical development, of deviance and delay, of remediating and ameliorating difference. The discussion of individuality, of models of disability and of how cognitive variance fits within them, stays within 'disability rights' research and rarely makes in-roads into psychological and developmental discussions. Education fares a little better, with discussions over equity and equality and what we mean by inclusive practice. However education research still very often prefers to discuss what we should be doing to improve the learning of individuals with different learning needs, rather than considering how the needs of these learners can be incorporated into the whole school community.

I have almost certainly fallen into the discourse of typical versus non typical at points. Indeed the results are discussed in the knowledge that what has been observed in our groups of children is a 'much slower' development than is seen in typically developing children. However I hope I have managed to stay true to an underlying commitment which allows children with Down's syndrome individuality, which describes their development as a particular trajectory and which opens up discussions about how researchers and educators view and talk about cognitive variance and different ways of learning.

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List of abbreviations

WM = working memory

EF = Executive function

IQ = Intelligence quotient

BPVS = British Picture Vocabulary Scales

FB = False belief

MA = Mental age

OP = Object permanence

SEN = Special educational needs

R = Researcher

Appendix 1: Parent information

Parent information pack

Lucy Dix - PGR student
University of Leeds
School of Education
Hillary Place
Leeds
LS2 9JT

Dear parent or carer,

Some of you will know me or my daughter, Kitty, who has Down syndrome, through our involvement with the Down Syndrome Training and Support Service Ltd (DSTSS). I began to teach some Early Development groups for DSTSS at The Pamela Sunter Centre in September 2011 and from there I developed a particular interest in how children with Down syndrome learn and how their specific learning styles affect their learning.

Thank you for taking an interest in this research project, I hope the information in this pack gives you a good idea of what the study is about, why it's an important piece of research and how you could be involved.

I began my research in September 2012 and I am now at a stage where I need to find volunteers to participate in my study. The time your child will need to be involved is minimal, at most about 3 hours, and this will be spread over a couple of weeks. We aim to run the assessments between October '13 and June '14. Your involvement will be to fill in some questionnaires to help us understand the background, health and language comprehension of your child. All of this is given in much more detail in the enclosed pack.

There is lots of information in this pack, but it doesn't matter if you don't read it all; I am running two information sessions where parents and carers are invited to come to ask questions and hear more about the study. These will take place May and will be at the Pamela Sunter Centre and at the University of Leeds.

If you would like to take part in the research, or you're not sure and you'd like more information, please contact me. You can email, phone, text or send a letter (you can leave post for me at the Pamela Sunter Centre, or send it to the address at the top). If you decide you would rather not take part, that's fine and you don't need to take any further action.

I am happy to discuss any aspects of my research and can be contacted on edled@leeds.ac.uk or 07973 513 806.

Thanks again for your interest in this study.

Lucy Dix

Lucy Dix

How does Theory of Mind develop in children with Down syndrome?

Parent Information Pack

Contents

What the research is about

This research will look at how a key aspect of development, called Theory of Mind, happens in children with Down syndrome.

Here are a few things that you are able to do as you develop a Theory of Mind, **some of them are very complex and don't fully develop until adulthood:**

- Know that things and people still exist even when you can't see, hear or touch them.
- Pretend and imagine in play.
- Understand different perspectives – know that other people see and think about things differently than you, and that they have different experiences than you.
- Put yourself 'in someone else's shoes' – and so work out why someone thinks or behaves the way they do.
- Be able to imagine a few perspectives all at once, and work out how those different perspectives might interact.
- Understand simple concepts of time – past, present and future.

Developing a Theory of Mind is important; it means children can be more flexible in their thinking and begin to use a wider set of skills, such as:

- Working out problems
- Imagining
- Using skills learnt in lots of different situations.

But these skills also put a huge strain on memory and brain power; you need to be able to think about lots of different solutions, perspectives and outcomes all at the same time.

Some adults and older children with Down syndrome have been tested in other studies to see how their Theory of Mind has developed, with very mixed results. These tests, which have involved lots of verbal instructions and questions, may not have given people with Down syndrome the best chance to show what they can do. All the tasks used in this new piece of research will be especially designed and changed to play to the strengths of children with Down syndrome; we will focus on visual and physical elements and care will be taken not to overload memory or use too much verbal instruction.

Over the course of the research we will look at three age groups; 2-3, 4-5 and 7-8. In the two youngest groups we will be looking for signs that children are developing the very early skills which we know lead on to the development of a Theory of Mind. The older children in the study will be tested to see if they are developing any aspects of Theory of Mind. As children with Down syndrome develop at roughly half the rate of typically developing children, we have doubled the ages at which typically developing children are tested for these skills.

As there has been very little research done in this area on children with Down syndrome, it is very difficult for us to predict what we will see in each of the groups of children. We may to be able to show that either Theory of Mind is developing and needs to be encouraged and supported in specific ways, or that Theory of Mind is very slow to develop and that children with Down syndrome need targeted help to ensure its development. We will also be looking at some aspects of language development and working memory, to see if they are linked in any way to how Theory of Mind develops.

Why this research is needed

Children with Down syndrome are now expected to be included as fully as possible in mainstream schooling. This research will add to discussions about creating the most appropriate school curriculum for children with Down syndrome. If children with Down syndrome develop their Theory of Mind later or slower than typically developing children this *may* impact on the type of curriculum they need.

We hope this research will begin to help teachers, practitioners and policy makers when thinking about what kind of curriculum children with Down syndrome need to help them succeed as learners.

Alongside other research to do with how children with Down syndrome learn, such as the Down Syndrome Educational reading intervention work, this research will help to build up a picture of what types of learning activities could be best used for children with Down syndrome and when to introduce particular areas of learning.

We hope this research will lead on to more studies about the development and learning of children with Down syndrome.

How you and your child could be involved

For each age group we need about 10 children to be involved with the assessment tasks, which are detailed in the next section.

The assessments will take place at different places for the different age groups, throughout the school year 2013/2014.

Children will be accompanied by either a parent/carer or a teaching assistant, who will remain in the room but will not be involved in the tasks.

Age	Where it will take place	What will happen	How long it will take	What parents need to do
2-3 years	Group Centre Or at your home	Either: A recording will be made of the Early Development Group which your child attends, in which the tasks are performed. OR You can come to the Pamela Sunter Centre, or I can visit your home to work with your child on the tasks.	The actual tasks will last no longer than 20 min. We will repeat the session 2 weeks later.	Parents will be asked to complete a questionnaire about the child's health and progress as well as a form about the child's speech comprehension.
4-5 years	Either at the Group Centre or in nursery/ school	We will record 1 session of the child playing with the researcher on some set tasks and 1 session of vocabulary and working memory tasks.	Each session will be about ½ an hour and there will be a break in the middle. We will repeat both sessions 2 weeks later.	Parents will be asked to complete a questionnaire about the child's health and progress as well as a form about the child's speech comprehension.
7-8 years	Either at the Group Centre or in school	We will record 1 session of the child working with the researcher on some set tasks and 1 session of vocabulary and working memory tasks.	Each session will be about ½ an hour and there will be a break in the middle. We will repeat both sessions 2 weeks later.	Parents will be asked to complete a questionnaire about the child's health and progress as well as a form about the child's speech comprehension.

What the assessment tasks will be like

We have designed a series of tasks which will show where the children are in terms of their development towards a Theory of Mind. We have tried to make the tasks enjoyable and playful and have kept in mind the learning strengths of children with Down syndrome. Instructions will be signed as well as spoken and the children's responses will be noted however they are communicated. ***Please be aware that these tasks will not show your child's overall development, they are designed for a specific purpose and to be carried out in specific ways***; the descriptions below are just to give you a general feel of the tasks.

Age 2-3
The children will complete the tasks as part of their usual Early Development Group or at your home. The tasks that will be observed will be;

a) The child pulling off a cloth/cup/box to reveal a toy hidden underneath.
b) The child watching a toy being hidden outside the room and then indicating as to where it is.
c) The child identifying his/her own image in a picture.
d) The child remembering where a picture of his/her carer/parent is once it has been turned over.
e) The child identifying the correct box containing an animal, given the choice of two.

Age 4-5
The children will be engaged in a 1:1 play session with the researcher.

a) The first part of the session will look at how the child pretends and imagines something which isn't there. We will play with some toys and then a 'cheeky teddy' puppet will come and spill imaginary milk on the floor or one of the other toys. I will ask the child to help clean it up.
b) In the second part of the session we will be looking at how the child can pretend one object is something else. We will play with a teddy or doll and some other objects. For example: I will ask the child to put a hat on the teddy, but there will be no hat amongst the objects; they will have to find a different object to pretend is a hat.
c) The third part of the session will be a language and working memory task. The child will be asked to point at pictures which will help us assess his or her level of language understanding.

Age 7-8
This group will have a 1:1 session with the researcher which will include:

a) 3 versions of a task which requires children to imagine someone else's point of view. 1 version will be played out with puppets, 1 will be looking at a book and 1 will be a video sequence. The children will be asked a question about what one of the characters thinks.
b) A 'false contents' task, where the child is shown a box which contains something different than what is pictured on it. We ask them about what other people might think was in the box.
c) The last part of the session will be a language and working memory task. The child will be asked to point at pictures which will help us assess his or her level of language understanding.

If at any point your child wants to stop the assessment, becomes tired or unwilling to carry on, we will stop the assessment straight away. Older children will be given a 'stop' card to help them indicate that they do not want to carry on. Younger children will be watched carefully for signs that they are not happy to continue.

What the assessments will tell us

The assessments will give us a snapshot of development at three age time points. From our observations we will have information which will tell us how many tasks were passed in the assessments, how they were passed, or how they weren't. This will be added together to give us group data so we can see how the group of children, as a whole, are developing. We will put our three sets of data, from the three age groups, together so we can show how the shape of development is similar or different to that of typically developing children.

The assessments are not designed to give us detailed information about the development of each child, as this is not the purpose of the research. The assessments give a very small window into a very particular task at a particular moment in time. Because of this it would be unfair to draw conclusions about individual children's overall development.

How you will get feedback

Feedback will happen in 2 ways:

Six weeks after each round of assessments a short report will be produced about the age group we have looked at. This will include how the group of children performed on the tasks and some initial findings. All data will be anonymous and information will be general, not personal. No names will be used. This will be available for parents in paper form or to view online; the findings will be unpublished and so we ask that at this stage you do not share them.

Ten weeks after each round of assessments I will arrange a feedback evening where I will give a broad outline of the information in the short report and answer any questions parents and carers may have on the group findings.

I will not be able to give individual feedback on your child as the assessments are not designed to provide individual developmental information and it would be unfair to use them in this way. As I am looking at the age groups as a whole I will not be able to report to you on your individual child.

Data protection and ethical guidelines

All information collected will be treated with the strictest confidence and in accordance to the University's guidelines on data protection.

Information about children, their families and their schools will be coded into untraceable codes, so that participants are only identified by this code, which will only be available to the main researcher. No names, images or information which could identify the child, the family or the school will be reproduced without explicit prior permission.

The video recordings of your child's activities made during this research will be used only for analysis and for illustration in conference presentations and lectures. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings.

You can withdraw from the study at any point up to September 2015. After this it will be very difficult to remove individual data from the study as it will already have been analysed and written into the results.

There will be no negative impact on your decision to withdraw. You do not have to give a reason for withdrawing.

This study is supervised by Dr Paula Clarke and Dr Mary Chambers at the University of Leeds.

We are working to the University's strict policies on data protection and ethical research which can be found here:

http://researchsupport.leeds.ac.uk/index.php/academic_staff/good_practice/university_ethics_policies

This research has been approved by the University's Ethical Review Panel. Reference: AREA 12-080

All researchers on this project have a current and recent CRB check.

This research is funded by the Frank Stell scholarship through the University of Leeds.

About me

I am a doctoral candidate at the University of Leeds and this research project is the focus of my studies. I hope it will have an impact on the way children with Down syndrome are educated and will lead on to lots more opportunities to develop the curriculum for children and young people with Down syndrome. After my PhD is finished I aim to continue researching and developing best educational practices for children with special needs.

I have been working with children with special needs for many years; initially as a classroom assistant in a school for children with Autistic Spectrum Condition, then as a teacher and Head of English in secondary schools and more recently through teaching Early Development Groups at the Down syndrome Training and Support Service.

I have a 3 ½ year old daughter who, amongst many other attributes, has Down syndrome.

My contact details:

Email: edled@leeds.ac.uk

Phone: 07973513806

Post:
Lucy Dix - PGR student
University of Leeds
School of Education
Hillary Place
Leeds
LS2 9JT

Website: https://www.pdr.leeds.ac.uk/web.php?pg=edled

Consent Form

Consent form to take part in the research study: ‘How does Theory of Mind develop in children with Down syndrome?’	Add your initials next to the statements you agree with
I confirm that I have read and understand the information pack and letter dated April ‘13, explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that our participation is voluntary and that we are free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. Contact: Lucy Dix 07973 513806	
I give permission for members of the research team to have access to my anonymised responses. I understand that our names will not be linked with the research materials, and we will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential.	
I agree for the data collected from me and my child to be used in relevant future research and for our data to be held securely in a data archiving facility. This includes using video extracts for teaching and conferences/seminars.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant and name of parent/carer	
Participant’s parent/carer signature	
Date	
Name of lead researcher	Lucy Dix
Signature	
Date (To be signed and dated in the presence of the participant).	

Child Participant Information Sheet

If printed, this sheet will be held securely in a locked cabinet and no copies will be made. The information will be transferred to the secure Leeds University computer system and the file will be password protected.

Please complete this form and return it to me at: edled@leeds.ac.uk or you can post it to: Lucy Dix - PGR student, University of Leeds, School of Education, Hillary Place, Leeds, LS2 9JT. Or leave it at the Pamela Sunter Centre. If you would like speak to me, so I can take the information from you on the phone, or in person, please call me on 07973513806, and I will ring you back.

First Name		Surname/family name	
Date of Birth		Male/Female	

What school or nursery does your child attend? (Or will attend from September 2013 if moving schools/nursery)	
Name of teacher/teaching assistant.	
Any medical conditions? *Please include all conditions I need to know about, even if they are associated with Down syndrome.*	
Anything else you would like me to know about your child (for example: finds music calming, dislikes bright colours, must stick to routines.)	
Name of main contact parent/carer	

I am happy for Lucy Dix to contact my child's school or nursery. (Please sign below, a typed signature is fine).

If you are finding it difficult to attach this to an email, you can just type the information into an email and send it to me that way, but please make sure you give me your agreement to contact your child's school/nursery.

Appendix 2: Protocols

Group 1 Protocol

Group 1 – age 2-3 years Testing early precursors of Theory of Mind
Assessment environment. Assessment to take place at school, home or at a group. Assessments will be held in a quiet space which is familiar to the child where possible. All sessions will be videoed. Present: the investigator, a parent, carer or teaching assistant.
Timescale The tasks will take 15 minutes. Sessions repeated after a 14 day gap (or similar) During the Autumn teaching term Sept- Dec 2013
Scoring Scored on pass/fail Also scored on how long it takes to complete the task and how many prompts are needed. For incorrect/fail answers, scoring includes codes to record how the child fails the task.
Communication Children's responses are through making physical choices; no other forms of expressive communication are needed to succeed in the tasks. Parents or TA's will be present to clarify expressive communication if needed.

Tasks	Episodes	Prompts		Scores
Task 1. Object permanence tasks Early evidence of developing theory of mind – knowing something exists when it is no longer visible.	A. 1 box Show child ball. Say and sign ball. Hide ball under box. Sign and say 'Where's the ball?'	*Prompt 1 after 5 seconds:* Where's the ball? *Prompt 2 after 10 seconds:* Name, where's the ball?	3	Finds object within 5 seconds
			2	Finds object after 1 prompt within another 5 seconds
	B. 2 boxes choice Show child car. Say and sign car. Hide car under a box. Sign and say 'Where's the box?'	*Prompt 1 after 5 seconds:* Where's the car? *Prompt 2 after 10 seconds:* Name, where's the car?	3	Finds object after 2 prompts within another 5 seconds
			0	Looks in incorrect place or doesn't choose a box
	C. 2 boxes choice, visible displacement Show child dog. Say and sign dog. Hide dog under a box. Say 'name, look' to ensure attention. Move the dog from one box to the other. Sign and say 'Where's the dog?	*Prompt 1 after 5 seconds:* Where's the dog? *Prompt 2 after 10 seconds:* Name, where's the dog?	-1	Removes box but attention on box
			-2	Doesn't find object – gaze averted/looks away
			-3	Distraction response - engages with researcher or carer off task

Tasks	Episodes	Prompts		Scores
Task 2 Reaction to a novel object	Name. Look. Make bird make a noise	Once bird has stopped look at bird and wait for sign or indication for 'more' or 'again' or 'stop'	3	Looks at experimenter to start or stop the bird
			2	Looks to parents or carer to start or stop the bird
			1	Moves towards or away from object to start or stop
			0	No change in behaviour or disengages

Tasks	Episodes	Prompts		Scores
Task 3 Joint attention	A. Rattle dolls to get attention. Once attention is on doll appear to struggle to take the top off. Put doll down in between exp and child.	**Prompt 1, after 5 seconds** Repeat action **Prompt 2, after 10 seconds** Repeat action	3	responds within 5 seconds, attempts to pull apart
			2	responds after 1st prompt after a further 5 seconds
			1	responds after 2nd prompt after a further 5 seconds
			0	picks up dolls and rattles/plays but does not attempt to open
			-1	does not respond
			-2	gaze averted, looks away
			-3	distraction response - engages with researcher or carer off task
	B. Shake tin to get attention	**Prompt 1, after 5 seconds** Repeat action	3	responds within 5 seconds, attempts to put in discs

	Once attention is on the tin try to put discs in tin, but miss. Have 2 more attempts then put discs down in between exp and child.	**Prompt 2, after 10 seconds** Repeat action	2	responds after 1st prompt after a further 5 seconds
			1	responds after 2nd prompt after a further 5 seconds
			0	picks up tin/discs and rattles/plays but does not attempt to put in
			-1	does not respond
			-2	gaze averted, looks away
			-3	distraction response - engages with researcher or carer off task
	C. Ensure child's attention, by calling name if necessary. Point at picture of teddy. Look through the containers to find the teddy. Give up looking after 3 boxes.	**Prompt 1, after 5 seconds** Repeat action **Prompt 2, after 10 seconds** Repeat action	3	responds within 5 seconds, attempts to search
			2	responds after 1st prompt after a further 5 seconds
			1	responds after 2nd prompt after a further 5 seconds
			0	picks up boxes, but does not search
			-1	does not respond
			-2	gaze averted, looks away
			-3	distraction response - engages with researcher or carer off task

Tasks	Episodes	Prompts	Scores	
Task 4 Picture book – alternative perspectives task	A.	Name, show me the duck? **Prompt 1, after 5 seconds**	3	responds within 5 seconds, turns book to show

	Carer and child to look through the book together, reading/naming pictures. Child must be holding book. When child turns to page with duck ask 'Can I see the duck?' or 'Show me the duck'. If child has moved onto another page, ask for animal on that page.	Name, show me the duck? **Prompt 2, after 10 seconds** Name, can I see the duck?	2	responds after 1st prompt after a further 5 seconds
			1	responds after 2nd prompt after a further 5 seconds
			0	points to picture in the book
			-1	does not respond
			-2	gaze averted, looks away
			-3	distraction response - engages with researcher or carer off task

Group 2 Protocol

Group 2 – age 4-5 years **Testing pretend play and symbolic functioning**
Assessment environment Assessments will take place either in schoo, at home or at a group, depending on parent preference. Assessments will take place in a separate room away from the main classroom if at school. Adults present – the researcher, if at school a TA or parent, if at home or group a parent/carer. All sessions will be videoed using a discrete digital camera.
Timescales Summer term – April/May 2014 40 min sessions Repeated 2 weeks later.
Scoring Children are scored on how long it takes to complete the task and how many prompts are needed. For incorrect/fail answers scoring includes codes to record how the child fails the task.
Communication Children's responses are through making physical choices; no other forms of expressive communication are needed to succeed in the tasks. Children will be given a STOP card to help them indicate if they need a break or wish to withdraw. Parents or TA's will be present to clarify expressive communication if needed.

<table>
<tr><th>Task</th><th>Notes</th><th>Episode</th><th>Prompts</th><th colspan="2">Scoring</th></tr>
<tr><td>BPVS</td><td></td><td></td><td>n/a</td><td></td><td>As per BPVS instructions</td></tr>
<tr><td rowspan="8">Transformations in pretend play. (Taken from Harris and Kavanaugh (1993)</td><td rowspan="8">In the original trial no prompts were given and the scoring was only pass/fail.
I have adapted the trial to ensure the children with Down syndrome are given the greatest chance to succeed by giving 2 prompts to remind them of the task.
The scoring is also adapted to consider how the children fail to engage with the task.</td><td rowspan="8">Episode A.-The props are a teapot, cups and a cloth. Exp. and child play with props, making the cats a cup of tea. Exp. says “oh no, look, here comes the cheeky bird.” The experimenter makes the cheeky bird pour make-believe tea over the cat situated to the right of the child and says, "Oh dear! The cat is wet. Can you clean where the tea is?" The child is then given the cloth.
Episode B.-The props are a cereal box, bowls, spoons and a brush. The experimenter makes Bird pour make-believe cereal on the floor beside the cat to the right of the child and says, "Oh dear! The floor is all dirty! Can you clean it?" The child is then given the brush.
Episode C.-The props are a tube of toothpaste (with the top on) and a cloth. The experimenter makes Bird squirt make-believe toothpaste onto the tail of the cat to the left of the child and says, "Oh dear! The cat is all dirty! Can you clean him?" The child is then given the tissue.</td><td rowspan="8">Prompt 1: After 10 seconds the question is repeated.
Prompt 2: After a further 10 seconds the question is repeated with the addition of explicit reference to where or what needs cleaning:
‘The cats head is wet! Can you dry the cat?’
‘The floor is all dirty here! Can you clean the floor?’
‘The cat’s tail is dirty! Can you clean the cat?’
‘The floor is all dirty here! Can you dry the floor?’</td><td>3</td><td>Correct response within 10 seconds</td></tr>
<tr><td>2</td><td>Correct response after 1st prompt</td></tr>
<tr><td>1</td><td>Correct response after 2nd prompt</td></tr>
<tr><td>0</td><td>Incorrect response - cleans wrong area or wrong cat</td></tr>
<tr><td>-1</td><td>No response – takes cleaning implement but does not clean</td></tr>
<tr><td>-2</td><td>No response – does not engage with task or experimenter – averts gaze</td></tr>
<tr><td>-3</td><td>Distraction response – engages with experimenter or carer</td></tr>
<tr><td></td><td></td></tr>
</table>

		Episode D.-The props are an empty carton of milk and a sponge. The experimenter makes Bird pour make-believe milk in front of the cat to the left of the child and says, "Oh dear! The floor is all wet! Can you dry it?" The child is then given the sponge.			
Teddy search task		Ensure child's attention, by calling name if necessary. Point at picture of teddy. Look through the containers to find the teddy. Give up looking after 3 boxes.	**Prompt 1, after 5 seconds** Repeat action **Prompt 2, after 10 seconds** Repeat action	3	responds within 5 seconds, attempts to search
				2	responds after 1st prompt after a further 5 seconds
				1	responds after 2nd prompt after a further 5 seconds
				0	picks up boxes, but does not search
				-1	does not respond
				-2	gaze averted, looks away
				-3	distraction response - engages with researcher or carer off task

Symbolic functioning. Taken from O'Toole and Chiat (2006)	Minimal adult modelling is required in this task to ensure that the child is not just mimicking.	Objects: ball, bricks, bowl, stick, shoebox Episode A: ball and bricks are put in front of child and teddy. Experimenter says, “Scarecrow really wants to eat an apple, can you give him an apple?’. Episode B: spoon and stick are put in front of child and Scarecrow. Experimenter brings out a sheet of paper and says, “Scarecrow wants to do some writing, can you find him a pencil?’. Episode C: bowl and ball are put in front of child and Scarecrow. Experimenter says, “Scarecrow’s head is really cold, can you put a hat on him?’. Episode D: bricks and shoebox are put in front of child and Scarecrow. Experimenter says, “Scarecrow’s feeling tired now. Can you put him to bed?’.	**Prompt 1:** After 10 seconds the question is repeated. **Prompt 2:** After a further 10 seconds the question is repeated with the addition of explicit reference to the object transformation. A: ‘What can we pretend is an apple?’ B: ‘What can we pretend is a pencil?’ C: ‘What can we pretend is a hat?’ D: ‘What can we pretend is a bed?’	3	Correct response within 10 seconds
				2	Correct response after 1st prompt
				1	Correct response after 2nd prompt
				0	Incorrect response – does not transform object
				-1	No response – plays with objects but without reference to question
				-2	No response – does not engage with task or experimenter – averts gaze
				-3	Distraction response – engages with experimenter or carer

Group 3 Protocol

Group 3 – age 6-9 years

Testing the emergence of Theory of Mind through false belief

Assessment environment.
Assessments will take place either in school, at home or at a group, depending on parent preference.
Assessments will take place in a separate room away from the main classroom if at school.
Adults present – the researcher, if at school a TA or parent, if at The Centre a parent/carer.
All sessions will be videoed using a discrete digital camera.

Timescale
Summer term February – July 2014
1x 40 min session
Repeated 2 weeks later.

Scoring
Children are scored on how long it takes to complete the task and how many prompts are needed.
For incorrect/fail answers, scoring includes codes to record how the child fails the task.

Communication
Children's responses are through making physical choices; no other forms of expressive communication are needed to succeed in the tasks.
Parents or TA's will be present to clarify expressive communication if needed.
Stop card given to child to enable a rest or withdrawal from the task.

Task	Notes	Episodes	Prompts	Scoring	
BPVS			n/a		As per BPVS instructions
False belief task; original and modified versions. (False belief)	All FB episodes are scored using the same criteria.	FB 1. Ex. shows 2 dolls, introduces one as Dinah and the other as Maxi. Ex. shows that Dinah has a toy.	After 10 seconds repeat the question "Where will Dinah look for the toy?"	4	Correct response within 5 seconds
				3	Correct response within 10 seconds

		Ex. makes Dinah put her toy in a drawer and shows Dinah 'going outside'. Ex. makes Maxi move the toy from the drawer to his box. Ex. makes Dinah re-enter and asks child 'Where did maxi hide the toy?' 'Where did Dinah hide the toy?' 'Where will Dinah look for the toy?' FB 2 Ex and child read through a comic book which shows the same story as the Dinah/Maxi story above. The characters are changed to a brother and sister. The sister hides her favourite story book from her brother who finds the book and then moves it. Children are asked 'Where did Maxi hide the book?' 'Where did Dinah hide the book?' 'Where will Dinah look for the book?' FB 3 The experimenter and the participant work together to create a picture story of the Dinah/Maxi task using a tablet. The child directs the pictures to be taken and the ex. facilitates the use of technology. FB 4 Repeat of episode 1.	After a further 10 seconds, draw attention to Dinah and the drawers (or equivalents in Ep 2+3) and repeat the question. "Where will Dinah look for the toy?"	2	Correct response after 1st prompt
				1	Correct response after 2nd prompt
				0	Incorrect response
				-1	No response – plays with objects but does not answer question
				-2	No response – does not engage with task or experimenter – averts gaze
				-3	Distraction response – engages with experimenter or carer

Unexpected contents task.		UC 1 Ex shows child a box which looks as though it contains crayons. “What do you think is inside?” Ex and child look inside to find socks instead of crayons. “What did you think was inside?” “Shall we trick ‘teacher/dad/mum’?” Ex and child work together to put socks inside the crayon packet. “What will ‘teacher/dad/mum’ think is inside the box? Ex and child show teacher/dad/mum box and play the ‘trick’.		4	Correct response within 5 seconds
				3	Correct response within 10 seconds
				2	Correct response after 1 prompt
				1	Correct response after 2prompts
				0	Incorrect response
				-1	No response – playing with objects
				-2	No response – does not engage with task or experimenter
				-3	Distraction response – engages off task with experimenter or carer

Appendix 3: Language questionnaires

Group 1

Dear Parent or Carer,

Thank you for taking the time to be involved in this research. As part of developing our understanding of the development of children with Down syndrome, we would like to collect some information about what type of communication your child uses and how often you refer to certain ideas in your everyday talk. We'd be very grateful if you could take 5 minutes to fill in the boxes below.

Child's name		**Date of birth**		**Your relationship to the child**	

Does your child:

Please tick under the appropriate box			
	never	occasionally	all the time
point to show you something			
hold objects out for you to see or play with			
show distress when someone is upset			

	not yet	in sign	in sign and speech	in speech
put a noun *(a naming word)* and adjective *(a describing word)* together for example: blue ball teddy wet				
use the term 'want' without prompting				
ask for more without prompting				

Please turn over...

How often do **you** use the following words with your child?

					Please tick under the appropriate box
target word	examples	Never	Once a month	Once a week	Daily
think	'I think it's here.' 'Where do you think it goes?'				
like	'I really like this song.' 'Do you like bananas?'				
want	'I want you to go in there.' 'Do you want a drink?'				
play	'I'd like to play with this.' 'What are you playing?'				
know	'I know where you're hiding!' 'Do you know whose house this is?'				
remember	'Hmm, I can't remember that.' 'Can you remember where it is?'				
pretend	'It's ok, I'm just pretending to be sad!' 'Can you pretend to be a mouse?'				
tried	'I'm so tired, is it bedtime yet?!' 'Are you tired?'				
worried	'Is she worried she will be late for school?'				
sad	'Why are you sad?' 'I'm sad because I banged my toe.'				
frightened	'The little mouse was frightened of the snake'.				

We are interested in the views of parents on research into Down syndrome. Please use the space below to suggest areas you would like to see more research in:

Groups 2 + 3

Dear Parent or Carer,

Thank you for taking the time to be involved in this research. As part of developing our understanding of the development of children with Down syndrome, I would like to collect some information about how often your child uses certain words and how often you refer to certain ideas in your everyday talk. I'd be very grateful if you could take 5 minutes to fill in the boxes below.

Child's name		**Child's date of birth**		**Your relationship to the child**	

Please tick the column which best fits the way your child uses the word **Please bear in mind these word lists are for a wide age range of children.**					
	does not yet understand	understands	signs/says in repetition or rote phrase	signs/says out of context	signs/says in context
want					
gone					
love					
like					
play					
show					
wait					
are					
is					
be					
could					
can					
do					
don't					
going					
try					
have					
choose					
pretend					
remember					
think					
mine					
his					
hers					
I					
it					
me					
my					
that					
this					
you					

your					
he					
her					
myself					
us					
we					
they					
good					
bad (naughty)					
clever					
cross					
happy					
pretty					
tired					
wet					
angry					
excited					
disgusted					
frightened					
sad					
scared					
surprised					
worried					
again					
day					
later					
now					
today					
tomorrow					
not					
other					
same					
after					
before					
next					
once					
time					
yesterday					
different					
a bit					
a lot					
each					
every					
lots					
some					
because					
if					
then					
why					

How often do **you** use the following terms with your child?

Please tick under the appropriate box					
target word	examples	Never	Once a mont h	Once a week	Daily
think	'I think it's here.' 'Where do you think it goes?'				
like	'I really like this song.' 'Do you like bananas?'				
want	'I want you to go in there.' 'Do you want a drink?'				
play	'I'd like to play with this.' 'What are you playing?'				
know	'I know where you're hiding!' 'Do you know whose house this is?'				
remember	'Hmm, I can't remember that.' 'Can you remember where it is?'				
pretend	'It's ok, I'm just pretending to be sad!' 'Can you pretend to be a mouse?'				
tired	'I'm so tired, is it bedtime yet?!' 'Are you tired?'				
worried	'Is she worried she will be late for school?'				
sad	'Why are you sad?' 'I'm sad because I banged my toe.'				
frightened	'The little mouse was frightened of the snake'.				

I would welcome your comments on the way my research has been conducted. Parent and carer views are useful to have when writing up results. Please feel free to put any comments below, or in an email to me.

I give my consent for these comments to be used anonymously ………………………………….(please sign)

I would like to ask your child's school about how they felt the assessments were carried out, whether they felt they were appropriate and how well they felt your child responded to them. I will send your child's TA, who was present at testing, a questionnaire to fill out. I will use their responses to support my research at conferences and in papers I write. All comments will be made completely anonymous.

I give my consent for Lucy Dix to contact the school for comments

………………………………….(please sign)

Appendix 4: TA and parent feedback

Group 2

TA Questionnaire Group 2

As part of my study I would like to collect some information and opinions from the Teaching Assistant/s who work with the children in my study. A number of teaching assistants who were present at the assessments made really interesting comments on the work I was doing and on the performance of the child in the assessments. Your comments will be really useful for me as I try to understand the nature of the performance of the child in context and will enable me to underpin my findings with examples from the people who work closely with the children in the study.

Any comments you make will be made strictly anonymous, your name and the name of the child will be changed and any other identifiers will be changed or removed (for example reference to area, or the school). This research has been approved by the University's Ethical Review Panel. Reference: AREA 12-080 and we are working to the University's strict policies on data protection and ethical research which can be found here:
http://researchsupport.leeds.ac.uk/index.php/academic_staff/good_practice/university_ethics_policies

Thank you for your support,

Lucy Dix

This information will be used purely for analysis purposes so that I can link your comments with the child you work with. Your comments will remain completely anonymous and you and the child and school will never be identifiable in my reports.
Your school:
Your name (optional):

The questions are here to guide you but are optional, please feel free to comment in any way you wish; all your comments will be useful.					
Your response to the use of a 'stop' card for the child.					
Your response to the use of the British Picture Vocabulary Scales (the picture cards which the child pointed to).					
How do you think the child responded to the BPVS?	Knew more words than I expected	Knew less words than I expected	Got words wrong which I think	Did not seem to enjoy the task	Seeme d to enj

			he/she knows		oy the tas k
Tick all that apply					
Any further comments on this task:					
Your response to the cheeky bird/cleaning the cats task.					
How do you feel the child responded to the task?	Got more questions right than I expected	Got more questions wrong than I expected	Performed as I expected	Did not seem to enjoy the task	See me d to enj oy the tas k
Tick all that apply					
Any further comments on this task:					
Your response to the imagination task – (the doll Alex).					
How do you feel the child responded to the imagination task?	Got more questions right than I expected	Got more questions wrong than I expected	Performed as I expected	Did not seem to enjoy the task	See me d to enj oy the tas k
Tick all that apply					
Any further comments on this task:					
Your response to the searching for the teddy task.					
How do you feel the child responded to the searching for the teddy task?	Performed as I expected	Did not seem to enjoy the task	Seemed to enjoy the task		
Tick all that apply					

Any further comments on this task:	

My study will be looking at how children's difficulties in Theory of Mind may impact on their access to the curriculum at primary school. Please use this box to add your comments about this:			
	Signed	Print name	Da te
I agree for my anonymised comments to be used by Lucy Dix as part of her research with the University of Leeds. I understand that this may be as part of her written work, publications and presentations.			

Please return by email or post.	If you would like a paper copy of this questionnaire please email, phone or text me and I will post one out to you.
Email:	edled@leeds.ac.uk
Post:	Lucy Dix PGR Student School of Education University of Leeds Hillary Place Leeds LS2 9JT
Phone:	07973513806

Group 3

TA Questionnaire Group 3

As part of my study I would like to collect some information and opinions from the Teaching Assistant/s who work with the children in my study. A number of teaching assistants who were present at the assessments made really interesting comments on the work I was doing and on the performance of the child in the assessments. Your comments will be really useful for me as I try to understand the nature of the performance of the child in context and will enable me to underpin my findings with examples from the people who work closely with the children in the study.

Any comments you make will be made strictly anonymous, your name and the name of the child will be changed and any other identifiers will be changed or removed (for example reference to area, or the school). This research has been approved by the University's Ethical Review Panel. Reference: AREA 12-080 and we are working to the University's strict policies on data protection and ethical research which can be found here:
http://researchsupport.leeds.ac.uk/index.php/academic_staff/good_practice/university_ethics_policies

Thank you for your support,

Lucy Dix

This information will be used purely for analysis purposes so that I can link your comments with the child you work with. Your comments will remain completely anonymous and you and the child and school will never be identifiable in my reports.
Your school:
Your name (optional):

The questions are here to guide you but are optional, please feel free to comment in any way you wish; all your comments will be useful.					
Your response to the use of a 'stop' card for the child.					
Your response to the use of the British Picture Vocabulary Scales (the picture cards which the child pointed to).					
How do you think the child responded to the BPVS?	Knew more words than I expected	Knew less words than I expected	Got words wrong which I think he/she knows	Did not seem to enjoy the task	Seemed to enjoy the task

Tick all that apply					
Any further comments on this task:					
Your response to the Dinah/Maxi story with dolls.					
How do you feel the child responded to the story?	Got more questions right than I expected	Got more questions wrong than I expected	Performed as I expected	Did not seem to enjoy the task	Seemed to enjoy the task
Tick all that apply					
Any further comments on this task:					
Your response to the digit span task (pointing to a series of numbers on the number line)					
How do you feel the child responded to the digit span task?	Got more questions right than I expected	Got more questions wrong than I expected	Performed as I expected	Did not seem to enjoy the task	Seemed to enjoy the task
Tick all that apply					
Any further comments on this task:					
Your response to the Dinah/Maxi book task.					
How do you feel the child responded to the Dinah/Maxi book task?	Got more questions right than I expected	Got more questions wrong than I expected	Performed as I expected	Did not seem to enjoy the task	Seemed to enjoy the task
Tick all that apply					

Any further comments on this task:					
Your response to the Dinah/Maxi ipad task.					
How do you feel the child responded to the Dinah/Maxi ipad task?	Got more questions right than I expected	Got more questions wrong than I expected	Performed as I expected	Did not seem to enjoy the task	Seemed to enjoy the task
Tick all that apply					
Any further comments on this task					

My study will be looking at how children's difficulties in Theory of Mind may impact on their access to the curriculum at primary school. Please use this box to add your comments about this:

	Signed	Print name	Date
I agree for my anonymised comments to be used by Lucy Dix as part of her research with the University of Leeds. I understand that this may be as part of her written work, publications and presentations.			

Please return by email or post.	If you would like a paper copy of this questionnaire please email, phone or text me and I will post one out to you.
Email:	edled@leeds.ac.uk
Post:	Lucy Dix PGR Student School of Education University of Leeds Hillary Place Leeds LS2 9JT
Phone:	07973513806

Appendix 5: Digit span task

Taken from : http://www.ppls.ed.ac.uk/psychology/people/sergio-della-sala

Original list up to sequence of 10, reproduced here up to sequence of 6

Stage 1. Determination of the Subject's Digit Span

Instructions to the Experimenter

You should have in front of you a sheet headed Lists for Digit Span Determination. You will see that lists are arranged in sets, those in each set being of the same length, the lists becoming progressively longer as you work down the page. In each set, there are nine lists, but that is to allow for the possibility of interruptions. The subject will receive only six lists for the actual determination of span.

Say to the subject that you are going to read them lists of digits, and that they are to try to repeat the digits **in the order in which they were read out**. If the subject seems unclear about what is required, go through an example, say, the list: 4, 7, 1. Read the digits in an even tone, at approximately the rate of **one digit per second**.

The subject should be tested on six lists, starting with length 2. Read out the digits at the rate of one digit per second. In the space provided, put a tick if the subject repeats the list correctly, and a cross if they do not. If the subject gets at least five out of the six lists correct, proceed to the lists in the next set. Continue this procedure until the subject gets two lists from the set wrong. At the bottom of the page, enter the subject's Digit Span as the **maximum length of the lists of which the subject recalled at least 5/6 correctly.**

Lists for Digit Span Determination

After each of the following lists, in the space provided, enter a tick (√) if the list is correctly recalled and a cross (×) if it is not. At the bottom of the page, in the space provided, enter the subject's Digit Span as the maximum length of the lists of which the subject recalled 5/6 correctly. Present only 6 lists to the subject.

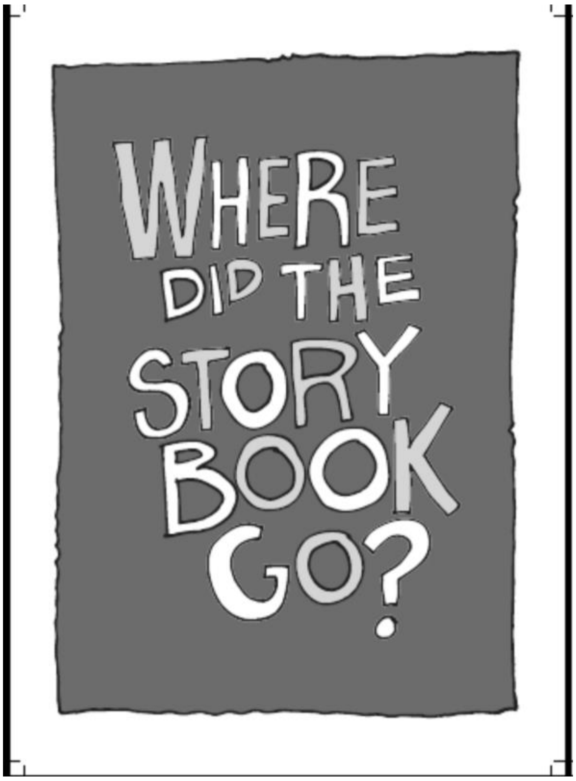
List	Result (√ or ×)	List	Result (√ or ×)	List	Result (√ or ×)
For Span = 2					
83		54		27	
28		37		91	
68		96		87	
For Span = 3					
829		687		871	
132		356		251	
152		637		915	
For Span = 4					
6241		1372		5316	
2359		7392		4815	
7132		6539		1872	
For Span = 5					
84132		85293		79514	
62143		91635		82691	
97438		16592		75468	
For Span = 6					
587261		492617		148239	
261384		247681		423896	
632147		429735		641357	

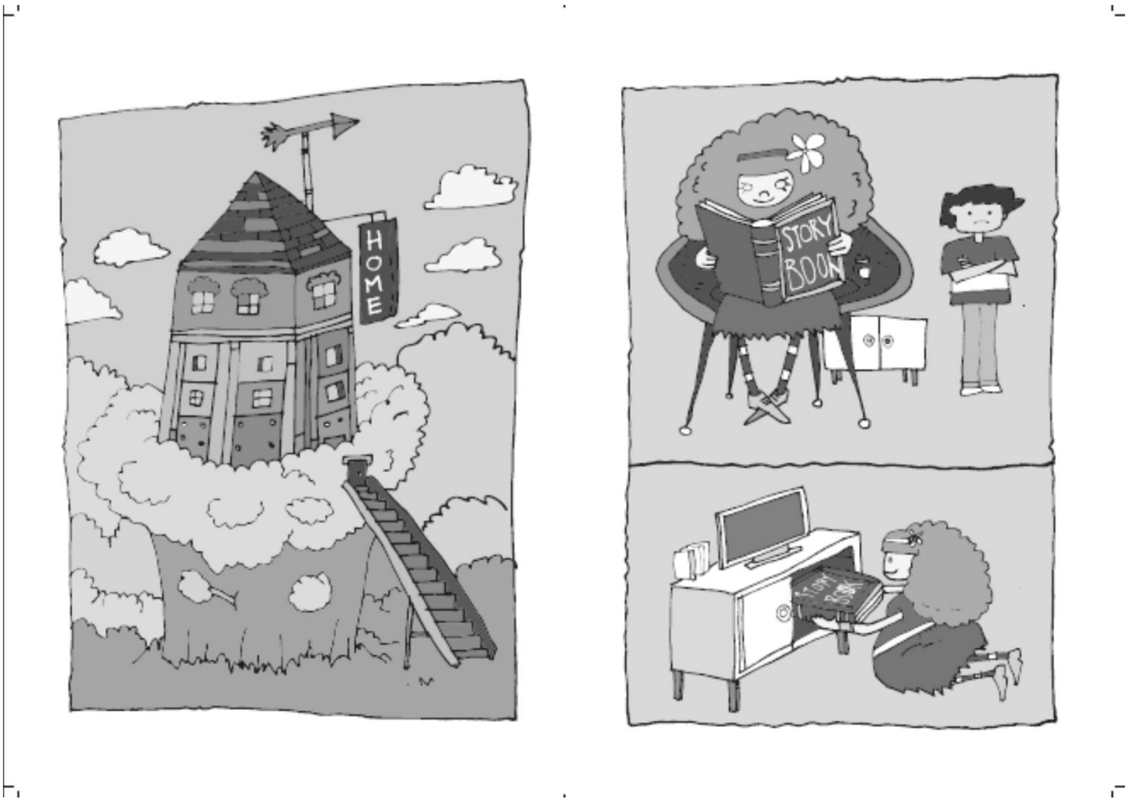
Subject's Digit Span =

Appendix 6: False Belief book

Kindly designed and illustrated free of charge by Matt Feres http://www.ferres.co.uk/

Original book in full colour






BOOK
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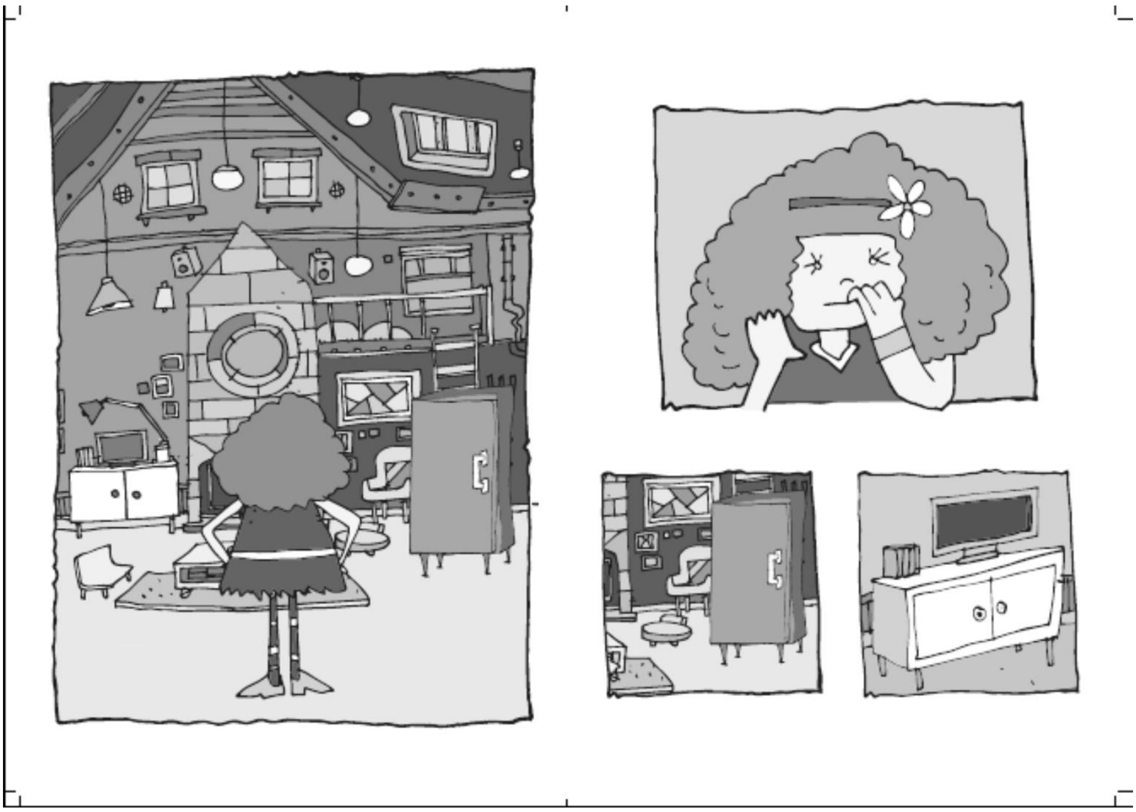
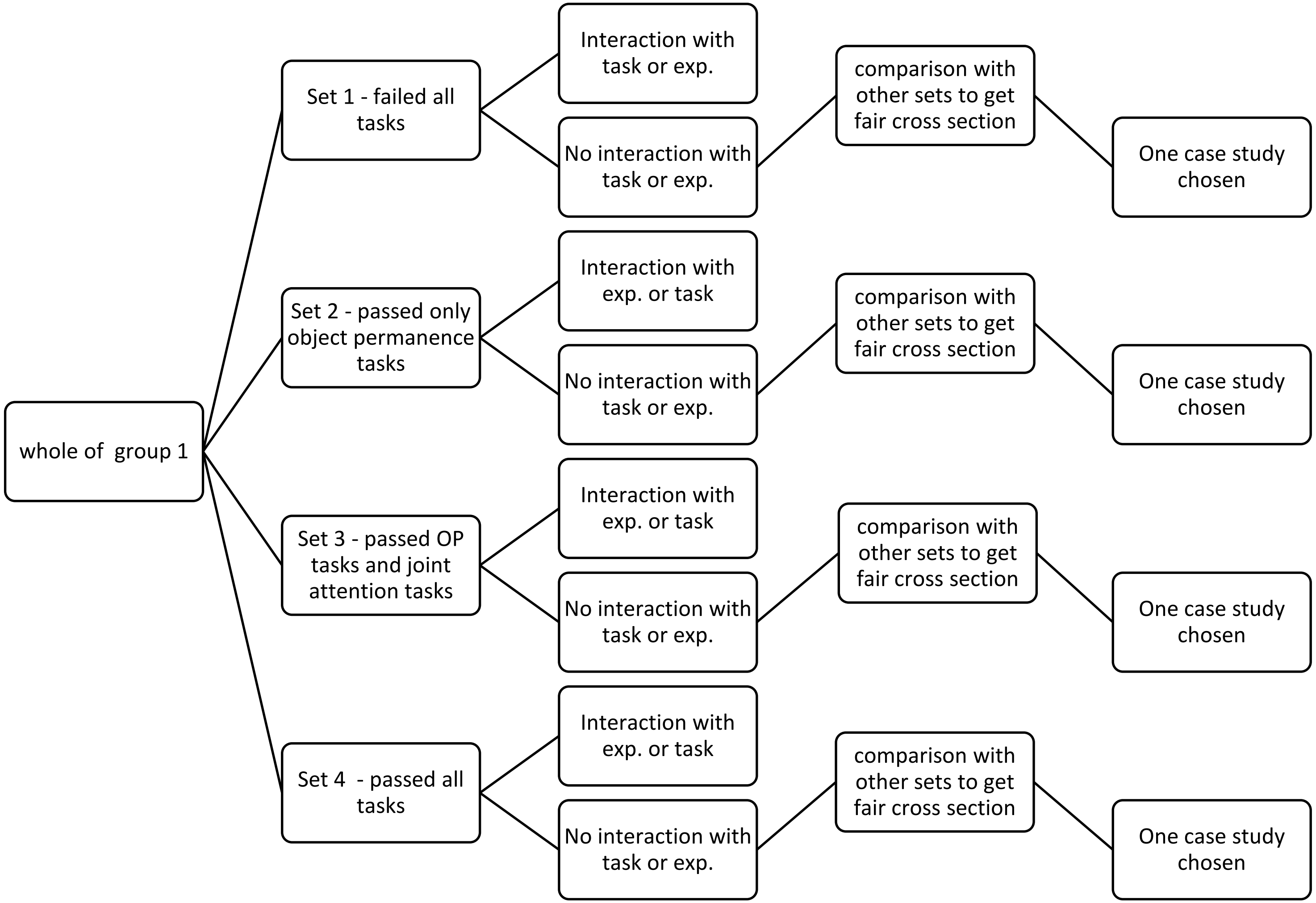
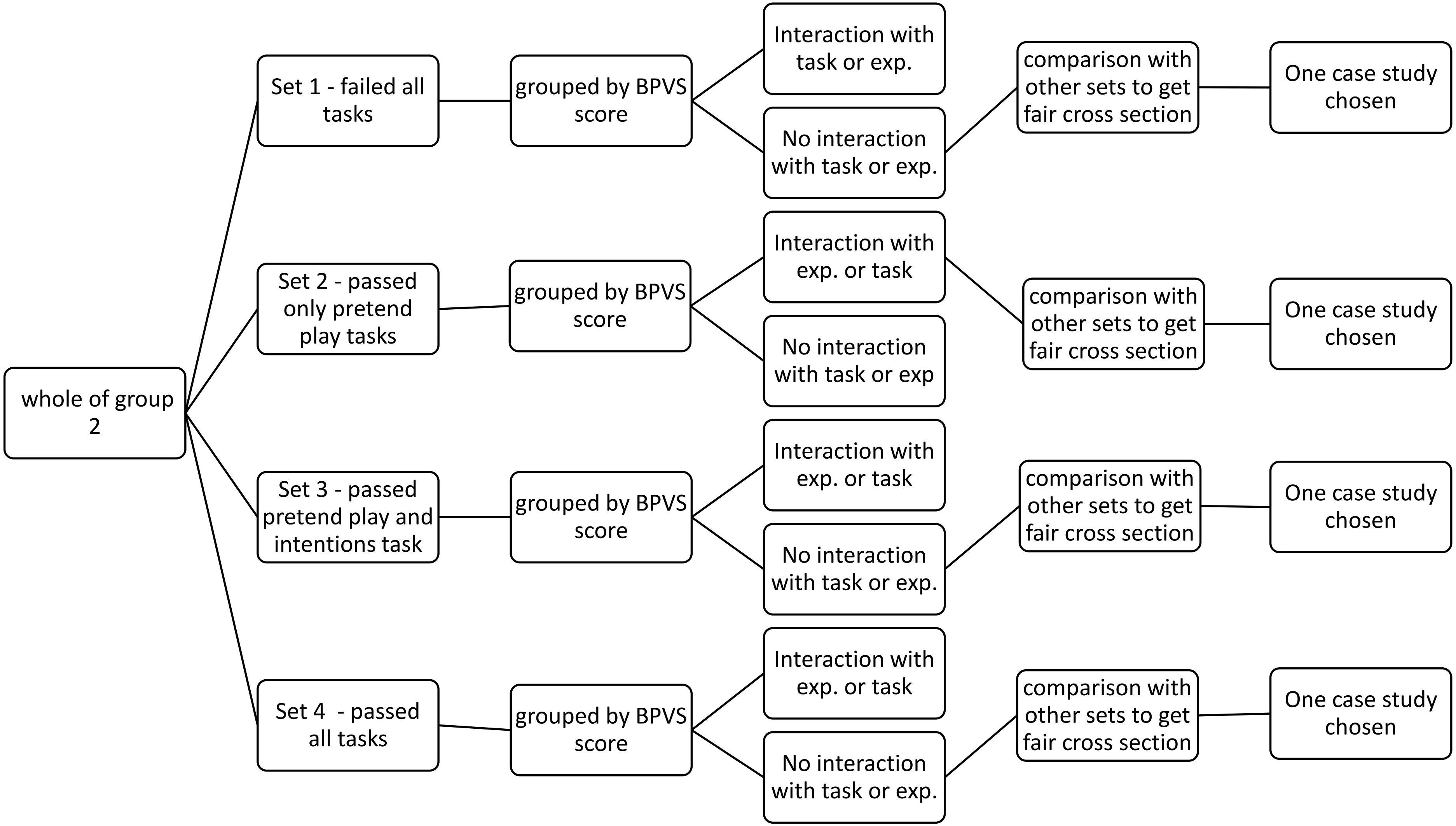
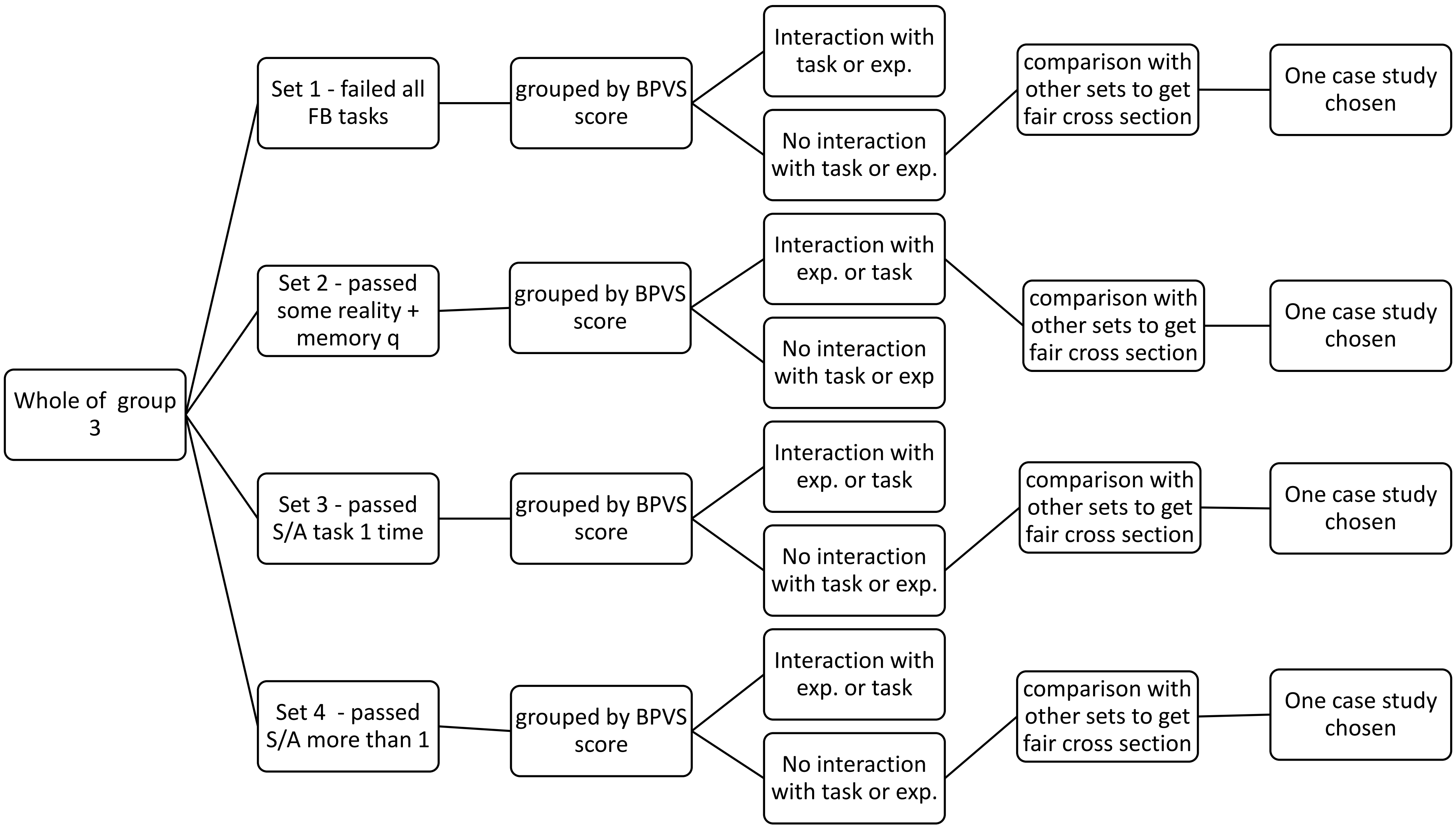


Appendix 7: Case series study rationale




whole of group 2
Set 1 - failed all tasks
Set 2 - passed only pretend play tasks
Set 3 - passed pretend play and intentions task
Set 4 - passed all tasks
grouped by BPVS score
grouped by BPVS score
grouped by BPVS score
grouped by BPVS score
Interaction with task or exp.
No interaction with task or exp.
Interaction with exp. or task
No interaction with task or exp
Interaction with exp. or task
No interaction with task or exp.
Interaction with exp. or task
No interaction with task or exp.
comparison with other sets to get fair cross section
comparison with other sets to get fair cross section
comparison with other sets to get fair cross section
comparison with other sets to get fair cross section
One case study chosen
One case study chosen
One case study chosen
One case study chosen


Whole of group 3
Set 1 - failed all FB tasks
Set 2 - passed some reality + memory q
Set 3 - passed S/A task 1 time
Set 4 - passed S/A more than 1
grouped by BPVS score
grouped by BPVS score
grouped by BPVS score
grouped by BPVS score
Interaction with task or exp.
No interaction with task or exp.
Interaction with exp. or task
No interaction with task or exp
Interaction with exp. or task
No interaction with task or exp.
Interaction with exp. or task
No interaction with task or exp.
comparison with other sets to get fair cross section
comparison with other sets to get fair cross section
comparison with other sets to get fair cross section
comparison with other sets to get fair cross section
One case study chosen
One case study chosen
One case study chosen
One case study chosen

Data analysis plan

Phase One – pass/fail quantitative analysis – tasks T1						
Scoring - tasks	Initial pass/fail marking on all tasks, all groups	Send sample for agreement marking	Re-mark – come to agreement			
Analysis	Pass fail patterns by age – within group	Pass fail patterns by task – within group	Create timeline of ToM development – between group			
Scoring BPVS	Raw score data					
Phase Two – qualitative analysis (T1) – Case series studies						
Gesture	In tasks	In BPVS	To experimenter	To others in room	Send sample for agreement marking	Re-mark – come to agreement
Pointing	In tasks	In BPVS			Send sample for agreement marking	Re-mark – come to agreement
Use of sign	In tasks	In BPVS	To experimenter	To others in room	Send sample for agreement marking	Re-mark – come to agreement
Body language	In tasks	In BPVS	To experimenter	To others in room	Send sample for agreement marking	Re-mark – come to agreement
Social interaction	In tasks	In BPVS	To experimenter	To others in room	Send sample for agreement marking	Re-mark – come to agreement
Focus	In tasks	In BPVS	On experimenter	On others in room	Send sample for agreement marking	Re-mark – come to agreement
Speech and speech sounds	Intelligibl e	Unintelligible	In relation to task/bpvs	Off task	Send sample for agreement marking	Re-mark – come to agreement
Exploring alternatives	Map findings onto alternative theories	Modular theories	Simulation theories	Theory theories		

Appendix 8: Ethical approval

Performance, Governance and Operations
Research & Innovation Service
Charles Thackrah Building
101 Clarendon Road
Leeds LS2 9LJ Tel: 0113 343 4873
Email: ResearchEthics@leeds.ac.uk

UNIVERSITY OF LEEDS

Lucy Dix

PhD student

School of Education

University of Leeds

Leeds, LS2 9JT

AREA Faculty Research Ethics Committee

University of Leeds

16 August 2016

Dear Lucy

Title of study: **Moving on from mechanical learning; how Theory of Mind develops in children with Down syndrome.**

Ethics reference: **AREA 12-080**

I am pleased to inform you that the above research application has been reviewed by the ESSL, Environment and LUBS (AREA) Faculty Research Ethics Committee and I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

Document	*Version*	*Date*
AREA 12-080 Ethical_review_Lucy_Dix_200740842_final.doc	1	13/03/13
Appendix 1 Protocol #1 March 13.docx	1	13/03/13
Appendix 2 Parent Information Pack .docx	1	13/03/13
Appendix 3 parent questionnaire (pilot 2).docx	1	13/03/13

Committee members made the following comments about your application:

- It is a complex area but your project is well thought through and carefully planned. You have given due consideration to all the issues.

Please notify the committee if you intend to make any amendments to the original research as submitted at date of this approval, including changes to recruitment methodology. All changes must receive ethical approval prior to implementation. The amendment form is available at

http://researchsupport.leeds.ac.uk/index.php/academic_staff/good_practice/managing_approved_projects-1/applying_for_an_amendment-1.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at

http://researchsupport.leeds.ac.uk/index.php/academic_staff/good_practice/managing_approved_projects-1/ethics_audits-1.

Yours sincerely

Jennifer Blaikie

Senior Research Ethics Administrator

Research & Innovation Service
On behalf of Dr Emma Cave

Chair, AREA Faculty Research Ethics Committee

CC: Student’s supervisor(s)