

**Speech Production in Farsi-Speaking Children with Repaired Cleft Palate**

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**Doctor of Philosophy**

**By**

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# Abstract

Studies have shown that a history of cleft palate often affects speech production. While similar patterns of atypical speech production have been reported across a variety of different, mainly European, languages (Henningsson & Willadsen, 2011), studies on cleft speech production in typologically different, non-European languages may provide important insights into how truly universal cleft speech characteristics are. Farsi, the national language of Iran, may present a particular and interesting challenge in speech production of individuals with cleft palate, on account of its phonological system. This report presents the results of an ongoing study, aiming to identify the speech characteristics of Farsi-speaking children and to compare these with features reported in cleft palate research for other languages.

The study used speech data taken from 21 Farsi-speaking children aged between five and ten years old with a repaired cleft palate and a comparison group of five typically-developing children also aged between five and ten, all resident in Tehran, the capital of Iran. Audio and video recordings were made of the participants’ speech production in single word naming and sentence repetition. The data were transcribed using narrow phonetic transcription, and the transcriptions formed the basis for completion of Farsi GOS.SP.ASS forms for each individual participant. From the analyses, atypical speech characteristics were divided into those related to the cleft palate, and those which are described as non-cleft developmental features.

Results indicate that the Farsi-speaking children with cleft palate used a range of features previously identified as cleft speech characteristics for other languages. However, some unusual speech features such as retroflex articulation were noted in the data indicating that compensatory strategies can vary according to the language in question. Some of these unusual speech behaviours (e.g., realisation of a tap as a lateral approximant) are attributed to the particular phonetic inventory and phonological system of Farsi.

This study of the speech of Farsi-speaking children with repaired cleft palate indicates that not all characteristics of cleft palate speech are universal. There is evidence of some Farsi-specific features. However since the Farsi data does contain many of the cleft-related articulatory and phonological characteristics reported in English and other languages, the findings from this study support the proposal to base a Farsi cleft speech assessment on the UK GOS.SP.ASS assessment.

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# Author’s Declaration

# 

I hereby acknowledge that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted to any academic institution for degree purposes.

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# Chapter1 Introduction

## 1.1 Background of cleft lip and palate

Cleft lip and palate is a unique defect which can affect the whole life of a child born with it. It is a complicated defect and individuals who are born with a cleft lip and palate have been documented to have a range of communication difficulties which appear in the early stages of their development, in addition to difficulties with growth and with hearing. Cleft lip and palate is one of the most frequently occurring congenital deformity with a worldwide incidence of 1.2/1000 (Rahimov *et al.,* 2012) and occurs in all races, sexes and socio-economic groups.

Speech and facial growth are the main aspects of development affected by cleft palate. Speech has been central to a number of areas of research including: comparison of type and severity of speech difficulties; and comparisons of the effects of the timing of surgical repair, surgical technique etc. Various studies provide useful information about speech production in children with cleft palate from a range of language backgrounds, especially those speaking English and European languages. These investigations have revealed similarities and differences in speech production depending on the language in question (Henningsson & Willadsen, 2011).

Developments in the management of cleft palate in the UK provide an example of the depth of understanding and expertise that can be made available to these children and their parents. Clinicians need specialist skills and specialist assessments. However, these skills and assessments are not universally available. In Iran there is no specialist speech and language therapy (SLT) provision, no research about the impact of a cleft palate on the development of Farsi speech, and no cleft-specific speech assessments to facilitate either research or clinical care. Thus the current study investigates the phonetic and phonological features of speech production related to cleft palate in children who speak Farsi.

## 1.2 Main aims of the study

The project aims to investigate how speech production is affected in Farsi-speaking children with a repaired cleft palate. Studies on other languages have shown that cleft lip and/or palate often affect speech production. The main aim of this project is therefore to describe the speech production of Farsi-speaking children who have had a cleft palate, and compare it to findings for other languages reported in the research literature.

Children with a cleft palate are at risk of both articulatory and phonological difficulties. This study explores patterns of typical and delayed phonological development, as well as phonological processes specifically related to cleft palate. It is essential to make a careful distinction between those processes that relate to normal or delayed phonological development, which have nothing to do with any structural abnormality, and those errors related to a history of cleft palate and/or associated hearing issues (Harding and Grunwell, 1998).

There are no MDT centres in Iran, and no specialist SLT services. It is likely that children with a cleft palate may not be receiving optimal treatment. In order for children with a cleft palate to be accurately assessed and treated in Iran, there is a need for clearer understanding and research.This investigation explores various aspects of speech in Farsi-speaking children with a cleft palate:

* types of cleft speech characteristics in children with a cleft palate who speak Farsi,
* similarities and differences between characteristics of cleft palate speech in Farsi and other languages, especially English,
* developmental speech features in typically-developing Farsi-speaking children, as predicted by the literature on typical Farsi speech development,
* comparison of how features compare with speech patterns identified in other languages for children of a similar age.

More detailed questions are presented in chapter 5.

## 1.3 Thesis overview

Chapters 1-3 consist of a review of the research literature related to cleft palate and its impact on speech development. The first part of Chapter 2 describes embryology, aetiology, prevalence of cleft palate and its effects on hearing, dentition, psychological status and feeding. The following part discusses patterns of speech development in children with and without cleft palate in general and in Farsi-speaking children in particular.

Chapter 3 reviews the literature on the assessment of speech production, focusing mainly on the assessment of cleft palate speech. A discussion of perceptual and instrumental analysis then follows, leading to a review of the advantages and disadvantages of existing speech assessment and analysis methods.

One goal is to identify the phonetic and phonological characteristics of Farsi-speaking children with a cleft palate. Therefore, the first part of Chapter 4 describes relevant phonetic and phonological features of Farsi. The second part sets out the assessment protocol which is an adaptation of GOS.SP.ASS’98 (Sell *et al.,* 1999) for the Farsi language. The changes and additions which have been made to the GOS.SP.ASS’98 (Sell *et al.,* 1999) are described in this part.

Chapter 5 describes the aims and the methodology of the study, presenting the research questions and detailing the methods employed to address these. As there are strengths and limitations of phonetic transcription, including issues of reliability, the next part of this chapter describes the procedures used to confirm the reliability of the transcription and perceptual ratings employed in this study.

Chapters 6 to 8 comprise the results of this research starting with the perceptual phonetic and phonological analysis of speech production in typically-developing children who speak Farsi, followed by analysis of speech production in Farsi-speaking children with cleft palate. This is because some information about typical speech development is essential in order to understand the patterns of speech production in the individuals with a cleft palate

Chapter 6 presents the results of the analysis of speech production in typically-developing children with a range of 5 to 10 years. The aims of this chapter are to identify the range of residual developmental speech features of typically-developing children and to compare these features with speech patterns identified in other languages for children of a similar age. Identifying these features of typical Farsi later speech development will allow for a more precise identification of cleft-s§pecific features in later chapters

Chapter 7 set outs the results of the analysis of speech production in children with a cleft palate. The aims of this analysis are to describe cleft speech characteristics, non-cleft developmental and atypical features and then to identify the differences and similarities between Farsi and other languages, particularly English.

Chapter 8 deals with types of variability in the speech production of these Farsi- speaking children with cleft palate. It covers variability in relation to target consonant type, as well as age and type of cleft.

In Chapter 9, the findings of the study are interpreted and discussed. Specific cleft speech characteristics identified in Farsi-speaking children with repaired cleft palate are highlighted and are then compared to the features reported in other languages.

The overall conclusions from the study are presented in Chapter 10. The first part of this explores the clinical implications of the speech production features identified in the Farsi-speaking children with repaired cleft palate investigated here. The final part summarises the strengths and weaknesses of this study and suggests directions for further research.

# Chapter 2 Cleft palate and speech development

## 2.1. Definition of cleft lip and palate

A cleft palate is an abnormal opening or a fissure in an anatomical structure that is normally closed (Watson, 2001). Cleft may occur in the lip, palate or both lip and palate. A cleft in the lip is due to failure of parts of the lip to come together early in foetal development, while a cleft in the palate occurs when the roof of the mouth does not fuse in the first twelve weeks of pregnancy (Watson, 2001). A cleft palate can affect the entire palate or part of it. The cleft in the palate causes a space which connects the oral cavity and the nasal cavity. Clefts are various in their length and width. Cleft lips have more negative visual impact in comparison with cleft palate while the latter, which can be harder to diagnose, may cause serious difficulties in swallowing and speech development.

## 2.2 Embryology

The most important changes which take place during facial development are between the fourth and ninth weeks of pregnancy (Watson, 2001). Most speech articulators develop in this time when craniofacial anomalies can also occur. The cleft palate is a result of developmental deviations during this period.

The cleft may occur anywhere along the Y-shaped lines of fusion between the primary palate and palatine processes as well as between the two palatine processes themselves. Therefore, cleft palates can vary from a small cleft in the uvula to complete bilateral cleft in the palate and upper lip. Figure 2.1 shows the y-shaped lines of fusion.

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figure 2.1 indicates the lines of palatal fusion, where the affected area is presented by a numbered box (Kernahan & Stark classification, 1958, p.435). Nose and nasal floors: Areas 1 and 5, Lip: Areas 2 and 6, Alveolous: Areas 3 and 7, Hard palate: Areas 4, 8,9 and 10, Soft palate: Area 11. Reproduced with permission.

A cleft lip and/or palate may occur with other congenital anomalies as a feature of certain syndromes such as clubfoot, Pierre Robin sequence and spina bifida. This type of cleft palate is called syndromic, whereas when cleft palate occurs in isolation, it is called non-syndromic.

Having knowledge of embryology and an overview of how cleft palate occurs is important for speech therapists as this craniofacial anomaly may have a profound effect on speech development.

## 2.3 Aetiology

The embryological basis for the cleft lip and palate was first suggested in the 15th century and the way that cleft palate occurs has been explained convincingly for more than half a century (Bhattacharya *et al.*, 2009). However, the definite cause of cleft palate has not yet been proved in most cases. Peterson-Falzone et al. (2010) and Watson et al. (2001) stated that the causes of cleft lip and/or palate are heterogeneous. Therefore, a single cause or single etiological model cannot describe the occurrence of all types of clefts. The cleft palate may appear because of single genes, chromosomal disorders or environmental factors. Although the cause of the occurrence of non-syndromic cleft palate is still unknown, there are many significant studies about the genetic and environmental causes (Dixon *et al.*, 2011). More than 300 syndromes are known to include the cleft palate as one of their characteristics (Murray, 2002; Mossey & Little, 2002). The cause of these syndromes is an abnormal gene such as in Treacher Collins syndrome, Velocardiofacial syndrome, Stickler syndrome, EEC syndrome and Van der Woude syndrome, all of which are autosomal dominant.

There are some chromosomal disorders in which the cleft palate is a feature but many children with these disorders have a short life span. An example of such as disorder is trisomy 13, Patau syndrome which is most common in relation to chromosomal disorder (Gorlin *et al*., 2001). Beside the significant findings of the genetic studies, research has examined the influences of environmental factors on the occurrence of cleft palate, such as the age of the parents and racial influences (McIntosh *et al*., 1995), smoking in parents (Werler *et al*., 1990; Romitti *et al*., 1999; Zeiger *et al*., 2005; Honein *et al*., 2007), maternal epilepsy (Friis, 1989) and alcohol abuse by parents (Romitti *et al.,* 1999). While the genetic and environmental factors are now clear, other factors such as the complex heterogeneity of the human race need further research (Melnick, 1992; Nemana *et al.,* 1992).

## 2.4 Incidence of cleft lip and/or palate

Cleft lip and palate occurring together are more common than either defect occurring alone (Jensen *et al*., 1988; Shaw *et al.,* 1991). The incidence of clefts in the world depends on many factors which include type of cleft, gender of the individual, racial groups and even geographical variations (Bender, 2000; Fraser, 1971; Jensen, *et al*., 1988; Vanderas, 1987). For instance, one study has stated that the highest incidence of cleft palate occurs in Asians or native North Americans, whereas the lowest has been seen in African populations (Gorlin *et al*., 2001). This difference could be due to congenital diversities in the specific race’s genes (Westreich, 2000). Research conducted by Jensen et al. (1988), Shaw et al. (1991) and Gorlin et al. (2001) reported that cleft lip and palate occurs more frequently than isolated cleft palate. Meng et al. (2006) and Jagomagi et al. (2010) studied the incidence of cleft lip and palate in relation to gender. They noted that both isolated cleft lip and cleft lip and palate are observed more in males, whereas isolated cleft palate is observed more in females.

It is estimated that this problem is increasing slowly because of a rise in environmental teratogens, lower neonatal mortality and increased marriage and childbearing among cleft patients due to better care (Watson, 2001). The incidence of cleft palate is approximately 1 in every 700 births worldwide (Bernheim *et al*., 2006; Mossey *et al*., 2009).

In the United Kingdom, the incidence of cleft palate is in 1 in every 700 births (Clinical Standards Advisory Group, 1998). Although some countries such as Denmark (Fogh-Anderson, 1942; Jensen *et al.,* 1988), have accurate data for the incidence of cleft palate there is no precise evidence about its incidence in many countries. In Malawi, an incidence of 0.7 per 1000 births is reported, which is low (Msamati *et al*., 2000). In the Middle East, studies have been conducted in some countries, for instance, Jordan where Al Omari et al. (2004) found that in every 1.000 live births, 1.39 has a cleft palate.

There are some obstacles to knowing the precise incidence of cleft lip and palate. For example, if anomaly in the fetus is diagnosed, the pregnancy may be aborted (Boyd *et al*., 2008). Moreover, many studies report only the incidence of cleft lip and/or palate in live birth and there is no report of it in miscarriages (Hodgkinson *et al*., 2005).

## 2.5 Cleft palate in Iran

Iran is a Middle Eastern country in western Asia with a population of approximately 75 million. Although the precise incidence of cleft lip and/or palate in Iran has not yet been identified, partial studies have examined incidence of cleft palate in particular hospitals or in certain parts of Iran. Taher, (1992) reported that 79 cleft lip and/or palate births were identified from 21,138 live births between 1983 and 1988 in one hospital in Tehran. He noted that 26.58% showed cleft lip, 56.96% cleft lip and palate, and 16.45% cleft palate. Furthermore, Jamalian, Nayeri and Babayan (2007) found that the incidence of cleft lip and/or palate in Tehran was 2.14 per 1.000 births between 1998 and 2005, while this was 0.97 per 1000 births in the north of Iran (Goalipour *et al*., 2007). Zandi and Heidari (2011) stated that the incidence of cleft lip/palate in Hamedan, a city in the west of Iran is 1.016 per 1000 live births and categorised them by gender: 53.4% male and 46.6% female. According to these studies, the incidence of cleft palate in Tehran is higher than the other cities. Additionally, cleft lip and palate (CLP) is the most common type of anomaly (53.5%) in Tehran. In term of risk factors which cause cleft lip/palate in Iran, chemical sulphur mustard gas that was used in the Iran/Iraq conflict (Taher, 1992), presence of cleft in parents and family members, maternal drug consumption, trauma, radiation, and smoking (Zandi & Heidari, 2011) have been reported.

Several high esteemed hospitals in Iran, particularly in Tehran and Isfahan, conduct various surgical procedures, including primary and secondary surgeries for cleft lip/palate. One of the government hospitals which specialises in orofacial disorders is Hazrat-Fateme hospital in Tehran. This hospital provides an organized, scientifically-based cleft lip/palate service that includes pediatric surgery, plastic surgery, audiology, dentistry, speech therapy, nursing, psychology and prosthetics. The individuals with cleft lip/palate are referred to the cleft lip/palate clinic for further evaluation and intervention. Moreover, Isfahan University of Medical Sciences established the first multidisciplinary team in mid-2005. It has added genetic, radiology and psychiatric services to its previous cleft palate services.

In spite of a great number of studies focusing on the relationship between cleft palate and speech production in many languages, few such studies have investigated Farsi. The purpose of this study is therefore to define the speech production characteristics of Farsi-speaking children with surgically repaired cleft lip/palate and compare and contrast them with the speech characteristics of typically-developing children who speak Farsi.

## 2.6 Classification

There are various deformities in cleft lip and/or palate and each individual affected has specific and unique clinical features. The features are classified into different groups for different aims including clinical practice, research and audit purposes (Watson, 2001). The classification of cleft lip and/or palate is important for speech and language therapists, in order to describe a particular cleft clearly to their colleagues and also to record the precise details of the cleft palate to achieve the best intervention.

There are various classification models which have been used for clinical practice or research over the years (e.g., Davis & Ritchie, 1922; Veau, 1933; Fogh-Andersen, 1942; Kernahan & Stark, 1958; Harkins *et al*., 1962; Spina, 1973; Tessier, 1976; Albery & Grunwell, 1993; Wenbin *et al.,* 2007). Most classifications are based on the processes of facial embryology shown in Figure 2.2.

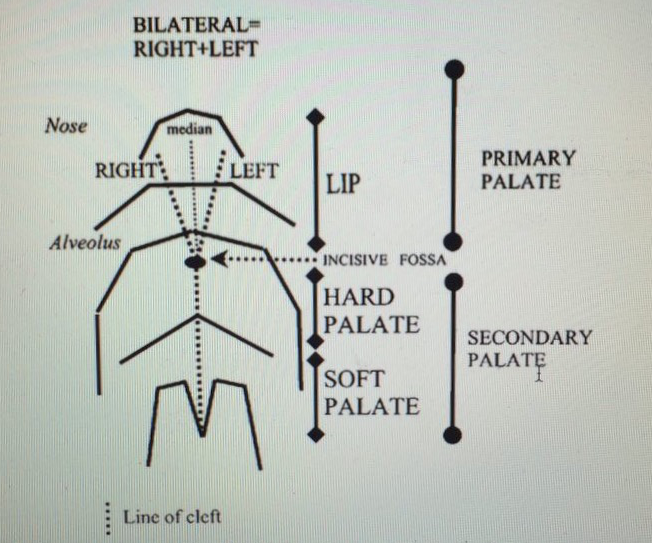


figure 2.2 Schematic representation of the lip and palate to explain the classification system (Hodgkinson *et al.,* 2005, page:5). Reproduced with permission.

Some symbolic methods have been used, of which the striped Y of Kernahan is perhaps the most common example. This classification system is divided into two major categories: the primary and secondary palates. The primary palate comprises the lip, alveolar ridge and triangle of the palate anterior to the incisive foramen in the primary palate section. Deformities in this part can be unilateral, median, bilateral, complete or incomplete. The secondary palate includes the rest of the palate posterior to the incisive foramen. The cleft in this area of palate can be complete, affecting the entire velum and hard palate to the incisive foramen, or incomplete, or involving the bifid uvula or the velum alone.

In the UK, there has been a general move to adapt a simple system, to be used for most purposes. It is based on the LAHSHAL system devised by Otto Kriens (1989), modified on the recommendation of the Royal College of Surgeons. This system allows clefts to be coded for computer use, especially on the Craniofacial Anomalies Register which has the aim of recording every cleft patient in Britain (Figure 2.3).

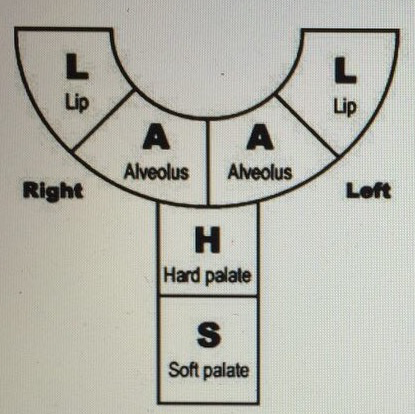


figure 2.3 LAHSAL system for the classification of cleft lip and/or palate (Hodgkinson *et al.,* 2005, p.5). Reproduced with permission.

The LAHSAL code is based on the striped Y classification. The mouth is divided into six parts including the right lip, right alveolus, hard palate, soft palate, left alveolus and left lip.

## 2.7 Effects of Cleft palate

Children with cleft lip and palate suffer from many problems associated with the cleft. In addition to speech difficulties, there may be problems with hearing; dentition; feeding, especially during infancy; speech production; communication; and psychological condition. The specific effects of a cleft palate on speech development will be considered in detail in section 2.7. This rest of this section introduces the wider effects of a cleft palate on hearing, dentition and psychological factors which may also affect speech and communication.

### 2.7.1 Hearing

One of the main problems which children with cleft palate face is hearing problems. Middle ear disease is a common ear problem, especially conductive hearing loss and Otitis Media with Effusion (OME) (Russell & Grunwell, 1993). Cleft palate is often associated with eustachian tube dysfunction and resulting conductive hearing loss (Kumar Sharma & Nanda, 2009). OME is a universal type of ear disease in infants with cleft palate (Paradise *et al*., 1969; Grant *et al*., 1988; Flynn *et al*., 2009). In the first year of their life 92-97 percent of children with cleft palate have this problem and this will continue in 70 percent of them until the age of four (Dhillon, 1988; Robinson *et al.,* 1992).

There is no evidence of anatomical obstruction of the eustachian tube in children with cleft palate. Thus, the eustachian tube dysfunction in children with a cleft palate is functional (Watson, 2001). In this situation, the eustachian tube cannot ventilate the middle ear sufficiently to clear mucus, resulting in a middle ear effusion (Arnold *et al*., 2005). Also, Bluestone et al. (1972) showed that liquid media flows from the middle ear into the nasopharynx, but not in the opposite direction, which confirms the functional problem in the eustachian tube.

Acute Otitis Media is another middle ear problem which is associated with pain, fever and hearing loss. This problem is seen in over 50% of children with cleft palate (Van Cauwenberge *et al*., 1994). Other ear problems which may be observed in individuals with cleft palate are tympanic membrane abnormalities, perforations and cholesteatoma. In general, children with cleft palate may be exposed to otitis media infection in the first two years of their life (Bluestone, 2004). Therefore, the probability of hearing loss in individuals with cleft palate is high. Hearing is a particularly important factor for speech and language development, especially in the first six years of life. Some studies have indicated that all children who suffer from frequent attacks of otitis media during this period are at risk of delayed phonetic and phonological development (Russell & Grunwell, 1993, Shriberg *et al.,* 2003). The occurrence of OME is high with 13% to 49% of individuals with cleft lip and palate presenting with this condition (Timmermans *et al*., 2006). It threatens the normal development of communication abilities in individuals with cleft palate and/or lip, in particular speech and language development. Therefore, hearing assessments at intervals from birth onwards is extremely important for children with cleft palate.

### 2.7.2 Dentition and occlusion

Individuals with cleft lip and/or palate encounter dental and occlusal problems. The most common dental problems are missing or mal-positioned teeth, rotated, crowding or supernumerary teeth, anterior cross bite, open bite, class III malocclusion and protruding maxilla (Proffit & White, 1991).

The disturbances which occur in the embryonic facial processes produce variations in number, morphology, enamel formation and eruption of teeth in the cleft area, with the lateral incisor being most affected (Bohn, 1963; Ranta, 1972, 1986, 1990). A missing lateral incisor in the permanent dentition manifests in 50% of the cleft palate population (Bohn, 1963; Ranta, 1986; Suzuki *et al*., 1992). Although canine morphology does not have a relationship with existence of cleft, these teeth are usually impacted (Semb & Schwartz, 1997). Malocclusion has been observed in many children with cleft lip and/or palate (Bugaighis, 2010). The type and severity of dental and occlusal problems depends on the type and severity of the cleft. Albery and Russell (1993) mentioned that complete cleft lip and palate could be a cause of abnormalities in the teeth, alveolar arch and occlusion while a cleft in the soft palate does not necessarily cause such abnormalities.

Dental and occlusal problems may cause the occurrence of speech disorders in individuals with cleft lip and/or palate. Johnson and Sandy (1999) proposed that presence, absence or malpositioning of single teeth does not have a significant effect on speech production, possibly because the individuals with cleft palate know how to use adaptive strategies in speech production, while Chait et al. (2002) noted that absent lateral teeth may affect speech production in children with a cleft palate. Based on 3D palatal imaging, Nishikubo et al. (2009) suggested that there is a link between malocclusion and misarticulation. They found that the general size and shape of the oral cavity affects speech production. This view is supported by previous research (Okazaki *et al*., 1991). According to studies by Pinsky and Goldberg (1977) and Shprintzen et al. (1985), the speech therapist must work closely with the dentist in the case of children with cleft who have dental problems that affect their speech. Furthermore, the structural abnormality of the dentition should be corrected before speech therapy is administered to children with cleft, because such therapy would not be effective without the intervention of dental treatment (Shprintzen, 1991). However, Albery and Russell (1990) suggested that the dental and occlusal problems in children with cleft palate are not the causes of speech unintelligibility. Moreover, Albery et al. (1985) stated that many children with cleft palate can produce speech sounds normally in spite of having severe degrees of alveolar arch, class III malocclusion and missing teeth.

### 2.7.3 Psychological status and feeding

Individuals with cleft lip and/or palate and their parents often experience certain psychological issues. These problems begin from the cleft palate diagnosis for the parents and from birth for the children with cleft palate. The awareness of having a child with cleft palate is extremely stressful for the parents. Drotar et al. (1975) identified as six successive stages of parental reaction to the birth of a child with cleft, which include shock, denial, sadness, anger, adaptation and reorganisation. They also noted that parents spent a variable amount of time in each of these stages. Another psychological issue for parents is dealing with the early needs of their child which are mainly centred on feeding and primary surgeries. It is well documented in many studies that comfortable and effective feeding creates a feeling of adequacy and competence in the parents. Interactive physical and vocal cues are important for interaction between a mother and the child (Speltz *et al.,* 1994). Furthermore, one of the first experiences in an infant’s life is to be fed. When there are any abnormalities in the oral cavity, pharynx or larynx, there could be a problem in this area. Moreover, feeding problem can be an issue for their parents (McWilliams *et al*., 1990). Bannister (2001) pointed out that the feeding problem has a strong relationship with the type of cleft. For example the feeding difficulties in children with cleft lip can be resolved in the early neonatal period, while children with cleft palate alone, especially those who have other medical problems or syndromes, may experience difficulties for many months (Bannister, 2001).

## 2.8 Surgical intervention and speech outcomes in cleft lip and palate

Although there is a long history of palatal surgery, there is still controversy about the best surgical techniques and optimal timing (Peterson-Falzone, Harding-Jones & Karnell, 2010). The basic reason for cleft palate repair is to establish a separation between the oral and nasal cavities, and to create a structure with potential for velopharyngeal closure mechanism. The primary aim of cleft palate repair is to achieve optimal speech outcome without compromising long-term maxillofacial growth. Rohrich et al. (2000) stated that a consecutive procedure with early velar closure at around three to six months, and hard palate repair at about fifteen to eighteen months, would be the best for facial growth and speech outcome. However, one-stage palatal repair between six and eighteen months is common (Lohmander *et al.,* 2011).

There are some studies that focused on the relationship between the timing and the technique of surgery intervention and speech outcome (Sommerlad, 1999). The speech outcome was categorised in terms of speech accuracy, prevalence or absence of nasal emission, hypernasality, articulation errors and good intelligibility. They reported that the less severe the cleft, the better the speech outcome. Surgeons have not yet agreed upon the surgical procedure that provides optimal potential for speech development in individuals who are born with a cleft lip and palate.

## 2.9 Speech development

Reviewing previous studies on speech development and the relationship between early speech and later speech enables us to distinguish between typical developmental patterns, atypical speech development which is unrelated to cleft palate and atypical speech development which is related to cleft palate. The remaining sections of this chapter review the relevant literature on patterns of typical speech development in general, (2.8) and in Farsi-speaking children in particular (2.9). In these sections pre-linguistic and linguistic phases including the transition from pre-speech phases to ‘one-word’ speech and early and later speech will be reviewed. This is followed by a review of speech characteristics reported in studies of children with cleft palate, (2.10).

### 2.9.1 Approaches to speech development research

Extensive research exists on speech development (Stokes & Wong, 2002; Beckman *et al.*, [2003](#_ENREF_3); [Tsurutani, 2007](#_ENREF_58); Vihman & Keren-Portnoy, 2013). The initial studies of speech and language development took the form of parental diaries. Some of the widely known early works on child language acquisition include Velten ([1943](#_ENREF_59)), Grégoire ([1937, 1947](#_ENREF_12)), Preyer ([1889](#_ENREF_39)) and Stern and Stern ([1907](#_ENREF_51)). These studies mainly aimed at describing patterns of speech and language development and other aspects of children’s behaviour in general. Even though these works have served as a stepping-stone for later studies, they are not without limitations. For example, diary studies report on patterns of speech and language development noted in one or two children, and thereby fail to provide a general picture as to how children in a certain speech community acquire their language. Moreover, most diary studies are not always very systematic, and do not tell us what to expect at what age, i.e., they do not provide norms for acquisition, as they focus on an individual child or few children.

In the late 1950s, due to the influence of behaviourism ([Skinner, 1957](#_ENREF_46)), the study of speech and language began to take systematic approaches and aim to provide normative data by studying large groups of children. One of these early large-scale studies is that of Templin, (1957), which investigated speech and language development in 480 children. It is important to note that even though such a study may provide information on, for example, what kind of speech sounds could be acquired by two or three-year old children, it would be difficult to extract information on how the individual child masters the various speech and language development milestones. The implication is that as much as large-scale studies are indispensable to understand the general speech and language development patterns, which in turn allows cross-linguistic comparisons, case studies provide invaluable insights into how an individual child goes about acquiring speech and language, which in turn shows individual differences.

With the paradigm shift from diary/case-studies to large sample studies, the methodology also evolved. Researchers became interested in conducting longitudinal studies, whereby the speech and language development of children is studied over time. Many studies following this approach have focused on looking for the emergence of rules and describing the developing grammar. These studies on the acquisition of grammatical features will not be reviewed here, as the main emphasis of the present study is on phonetic and phonological aspects of speech development. Hence, the remainder of this section is devoted to reviewing acquisition of phonetic features and their phonological consequences.

A number of theoretical frameworks have been employed in studies on phonological development, which include Jakobson ([1941/1968](#_ENREF_18)); Waterson ([1971](#_ENREF_62), [1987](#_ENREF_63)); Smith ([1973](#_ENREF_48)); Stampe ([1987](#_ENREF_50)). Jakobson’s (1941/1968) work is one of the most cited. He proposed that (a) the sounds babbled by infants are the sounds of all languages; (b) there is a discontinuity between babbling and first word; and (c) the order in which phonemes are acquired is universal. However, questions regarding the association between babbling and first words and later speech, and individual variations in phonological development continue to energize research. Another framework is Waterson’s ([1971](#_ENREF_62), [1987](#_ENREF_63)) prosodic approach to phonological development, which involves a perceptual schema in which “a child perceives only certain of the features of the adult utterance and reproduces only those he is able to cope with’’ ([Waterson, 1971](#_ENREF_62), p.181). This model also questioned the idea that the phoneme or a feature is the basic unit of representation for a child, as it was assumed to be for the adult. Following these approaches, various researchers have documented the milestones of speech development across languages, which suggest that children follow a set of universal milestones both in speech production and speech perception (Vihman *et al*., 1985; Elbers & Wijnen, 1992; Vihman 1992; Vihman & Keren-Portnoy, 2013). They suggested that the speech production in children learning different languages is broadly similar. In the following section, the most important stages of speech development will be dealt with in turn.

### 2.9.2 Pre-speech vocalisations and order of sound acquisition

Vocal behaviours occurring during various stages of speech development within the first year are not easy to define and are often a source of debate among researchers. At first infants produce vegetative sounds, which are related to biological function or physical state (e.g., coughing, sneezing, crying) and non-vegetative sounds (e.g., cooing). These rudimentary sounds are categorised as pre-speech vocalisation, also known as pre-linguistic vocalisation. Oller ([1980](#_ENREF_32), [1986](#_ENREF_30)) uses the phrase ‘cooing’ to refer to the type of vocalisation that generally emerges after that of the production of basic biological sounds such as crying (i.e., roughly after 1.5 to 2.5 months). In addition, the stage that generally comes between 6 to 10 months is named ‘canonical babbling’ Oller ([1980](#_ENREF_32), [1986](#_ENREF_30)) and ‘babbling’ (Vihman *et al.,* 1985; Koopmans-van Beinum & Van der Stelt, 1986). A more technical and elaborate definition of canonical or reduplicated babbling is given by MacNeilage (2013, p. 301): ‘’…one or more instances of a rhythmic alternation of a closed and open mouth, produced by a mandibular elevation/depression cycle, accompanied by vocal fold vibration, and linguistically meaningless, though giving the perceptual impression of a consonant-vowel (CV) sequence.’’

There is a general consensus in the literature that the appearance of canonical babbling in infancy is developmentally significant as well-formed syllables such as *baba*, *dada*, *mama*, are the basic elements of later speech.

The vast majority of words in natural languages are formed of canonical syllables. In relation to the emergence of babbling, and first word, one of the questions often asked is regarding which sounds are acquired first and which are learned last. In relation to English, this has been an area of research for a long time (e.g., Wellman *et al.,* [1931](#_ENREF_64); Poole, [1934](#_ENREF_37); Templin, [1957](#_ENREF_53); Olmsted, [1971](#_ENREF_33); Prather, [1975](#_ENREF_38); Smit *et al.*, [1990](#_ENREF_47)). Dodd et al. ([2003](#_ENREF_9)) summarised the results from these studies, and the order of sound acquisition (Appendix 1). However, it should be noted that all these studies are about English only.

There are two ways to analyse the development of sounds in the speech of children: phonetic versus phonemic acquisition i.e. speech sound production versus speech sound use (Dodd *et al*, 2003). Phonetic acquisition is associated with articulatory and motor skills, whereas phonemic acquisition is related to functions and organisation of the speech sound system. As shown in appendix 1 various criteria have been used in different well-cited studies such as sample size, age, elicitation method. Therefore, the results are different. For example, Wellman et al. (1931) and Templin (1957) found that the age of acquisition of /m, n, k, ɡ/ are earlier than Poole’s (1934) study. However, this might have occurred as a result of Poole’s study using stricter criteria relating to age. Wellman et al. (1931) and Templin (1957) are the two studies which have most similarities. Both studies reported the acquisition of seven consonants at the same age, eleven consonants with a one year difference and two consonants with two years’ difference (Appendix 1). This might have been because both studies employed the same criteria. Despite differences between the results of the studies summarised in appendix 1 there are some similarities in them. For example, nasal and stop consonants, /m, n, p b/, are produced earlier than other consonants and fricative sounds, /h, z, ʒ/, are the last speech sounds which appear in the children’s speech.

### 2.9.3 Speech development from early words to full phonemic inventory

Generally, a child’s first words are usually produced within the first year. Children use consonants and syllable types that were used in the babble stage, in their early words. They start using meaningful single words and their vocabulary increases. As they progress beyond the first ‘50 word’ stage, phonemic development progresses towards more adult-like speech (Stoel-Gammon and Dunn, 1985). By the age of two, children can usually produce 250 to 350 words and multiword sentences. Coplan and Gleason (1988) reported that speech is 75% intelligible by the age of three, and by the age of four completely intelligible. The full phonemic inventory, which means all sounds in all word and syllable positions as they occur in a given language, is finally acquired in the final stage between five and seven years of age (Dodd *et al.,* 2003). It is noteworthy that there could still be minor articulatory or phonological immaturities in typically-developing children after the age of seven. Dodd et al. (2003) reported that ninety percent of children over six years of age had error-free speech.

### 2.9.4 Phonological processes framework

According to natural phonology theory (Donegan & Stampe, 1979; Stampe, 1979), typical phonological processes describe phonetically motivated and natural patterns of speech production. Edwards and Shriberg (1983) stated that typical phonological development can be described using phonological processes. These processes are systematic sound changes which affect a class of sounds or sound sequences. For example, children’s use of simple forms of adult words is universal.

Ingram (1976) and Grunwell (1975, 1981) represented systematic speech features in the typical speech production of children with regard to normally developing phonological processes. Subsequently these phonological processes have provided a framework for speech assessment and intervention (Howard, 2011). This framework offers a possibility to categorise speech of children based on the phonological processes they use.

Normal developmental phonological processes can also be categorised by Ingram as:

1. A *syllable/word structure process* which is comprised of final consonant deletion, cluster reduction, weak syllable deletion
2. An *assimilation process* that occurs when one sound assimilates to another sound in the same word. It includes consonant place assimilation (labial, alveolar and velar assimilation), context sensitive devoicing (pre-vocalic voicing), and word final devoicing, reduplication.
3. A *substitution process*: These classification variations include stopping, fronting, gliding and vocalisation.

Grunwell (1981) classified different phonological processes as normal developmental delay or atypical phonological processes. Atypical processes were categorised as persisting normal processes, chronological mismatch and idiosyncratic processes. Persisting normal processes are those processes that child continues to use them beyond the age when this feature of normal development would be appropriate. Chronological mismatch is when the sequence of normal phonological process is disrupted and idiosyncratic processes are atypical processes which are not in the normal phonological development.

In terms of the relationship between pre-speech vocalisations and early speech, in the past (e.g., [Jakobson, 1941/1968](#_ENREF_18)), as pointed out earlier, the relationship between the two stages of speech development in typically-developing children was considered to be minimal. However, further research over the years has shown that, in typically-developing children, there is a universally attested similarity between the phonetic features of babbling and early phonology (Oller, [2000](#_ENREF_31); Nathani & Oller, 2001; [Vihman & Kunnari, 2006](#_ENREF_60)). As the child’s phonology continues maturing, there are various phonological patterns occurring at different phases of speech development which are reported to occur in children speaking different languages (e.g., [Smith, 1973](#_ENREF_48); [Srivastava, 1974](#_ENREF_49); Grunwell 1982; Dodd, 1995; James, 2001; [Mekonnen, 2008](#_ENREF_24)). These phonological processes include stopping, word-final devoicing, context sensitive voicing and final consonant deletion. Bernthal et al. (2009) summarises two studies about ages at which typically-developing children develop out of various developmental phonological processes (Table 2.1).

Table 2.1 An overview of studies on age and development of developmental phonological processes, reproduced from Bernthal et al. (2009)

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| **An overview of studies on age and development of developmental phonological processes, reproduced from Bernthal et al. (2009)** | | |
| **Age** | **Grunwell (1982, 1987)** | **Dodd et al. (2003)** |
| 2;0 | Weak syllable deletion, final consonant deletion, cluster reduction, fronting of velars, stopping, gliding, context-sensitive voicing |  |
| 2;6 | Weak syllable deletion, cluster reduction, fronting of velars, fronting /ʃ/, stopping /v, ʒ, tʃ/, gliding, context-sensitive voicing |  |
| 3;0 | Weak syllable deletion, stopping /v, θ, ð/, fronting / ʃ, tʃ, dʒ/, gliding | Gliding, deaffrication, cluster reduction, fronting, weak syllable deletion, stopping |
| 3;6 | Stopping / θ, ð/ | Gliding, deaffrication, cluster reduction, fronting, weak syllable deletion |
| 4;0 | /θ/ → [ð], /ð/ → [d, v], depalatisation of /ʃ, tʃ, dʒ/, gliding | Gliding, deaffrication, cluster reduction (3-element clusters) |
| 4;6 |  | Gliding, deaffrication |
| 5;0 | Stopping / θ, ð/, gliding /r/ | Gliding |
| 5;6 |  | Gliding |

This is important normative data, particularly for clinical purposes, which can be used by clinicians to determine which process to expect at what age.

## 2.10 Background to speech development in Farsi language

### 2.10.1 Usage of Farsi language

The Persian language is a branch of the Indo-Iranian subfamily of the Indo-European languages. It is spoken by nearly 110 million people in the world. It is difficult to distinguish every dialect of Persian due to their huge number and diversity. However, there are three dialects that are mostly close and mutually intelligible: Farsi, Dari and Tajik. Persian is an official language of Iran, where it is known as Farsi; it is considered to be the most modern dialect of Persian. Dari has been an official language of Afghanistan since 1958 (Olesen, 1995). Tajik, spoken in Tajikestan, has been an official language there since the Soviet era (Baker and Malmkjr, 1998). Additionally, Persian is spoken in countries such as Uzbekistan, Iraq, Armenia, Bahrain and Oman which have historically been influenced by Persian culture.

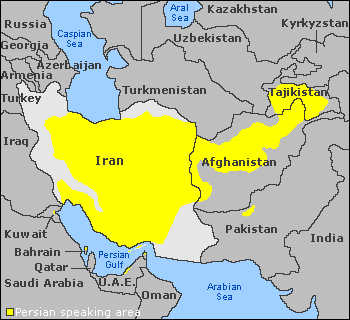


figure 2.4 shows the Persian speaking area in yellow (UCLA, language materials project)

### 2.10.2 Phonetics and phonology of Farsi

The Farsi phonological system is comprised of 23 consonant phonemes and 6 vowel phonemes (The International Phonetic Association, 1999)

### 2.10.2.1 Consonants

The classification of Farsi consonants is illustrated in table 2.2 based on the place and the manner of articulation.

Table 2.2 Farsi Consonants and allophones (International Phonetic Alphabet (IPA), 1999, p.124). Note: The symbols in brackets represent allophones.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | [Labial](http://en.wikipedia.org/wiki/Labial_consonant) | [Alveolar](http://en.wikipedia.org/wiki/Alveolar_consonant) | [Post- alveolar](http://en.wikipedia.org/wiki/Postalveolar_consonant) | [Palatal](http://en.wikipedia.org/wiki/Palatal_consonant) | [Velar](http://en.wikipedia.org/wiki/Velar_consonant) | [Uvular](http://en.wikipedia.org/wiki/Uvular_consonant) | [Glottal](http://en.wikipedia.org/wiki/Glottal_consonant) |
| [Nasal](http://en.wikipedia.org/wiki/Nasal_stop) | m | n |  |  | [ŋ] |  |  |
| [Stop](http://en.wikipedia.org/wiki/Stop_consonant) | p b | t d |  |  | k ɡ | [q ɢ] | ʔ |
| [Affricate](http://en.wikipedia.org/wiki/Affricate_consonant) |  |  | tʃ dʒ |  |  |  |  |
| [Fricative](http://en.wikipedia.org/wiki/Fricative_consonant) | f v | s z | ʃ ʒ |  | x ɣ |  | h |
| [Tap](http://en.wikipedia.org/wiki/Tap_consonant) |  | ɾ |  |  |  |  |  |
| [Trill](http://en.wikipedia.org/wiki/Trill_consonant) |  | [r] |  |  |  |  |  |
| [Approximant](http://en.wikipedia.org/wiki/Approximant_consonant) |  | l |  | j |  |  |  |

The Farsi consonants as listed in The Handbook of the International Phonetic Association (1999) will now be presented according to manner of the articulation.

1. Seven plosive or stop consonant phonemes, which have allophonic variants according to position: /p, b, t, d, k, ɡ, ʔ/.

Mahootiyan, (1997) stated that /p, t, k/ are strongly aspirated in the initial position of a word, for instance,[t ͪup] ‘ball’ , but they are only slightly aspirated in the other word positions. Aspiration is not a contrastive feature in Farsi (Mahootiyan, 1997). Two plosives /t/ and /d/ are apico-alveolar or apico-dental. Moreover, /b, d/ are slightly devoiced in word-final position. It should be noted that there is some discussion about glottal stop /ʔ/. Some linguists (Najafi, 1979) propose that it is an allophone, especially when it is used in the initial position of the word that begins with a vowel whereas some researchers suggest that this is a phoneme of Farsi because the presence of a word-final glottal stop can change the meaning of some words. For example /su/ means ‘side’ and /suʔ/ means ‘bad’ (The International Phonetic Association, 1999).

1. Nine fricatives:/f, v, s, z, ʃ, ʒ, x, ɣ, h/. The four voiced fricatives, /v, z, ʒ, ɣ/, are devoiced to some extent in the final position of the word and also /v/ is realised as [w] after /o/.
2. Two affricates: /tʃ, ʤ / which are post alveolar.
3. Two nasal consonants. /m, n/ and their allophone [ŋ].
4. One tap consonant which is an alveolar tap: /ɾ/.
5. Two approximant consonants: /l, j/, where the first is a voiced alveolar lateral approximant and the second a voiced palatal approximant.

### 2.10.2.2 Allophonic variants

According to International Phonetic Alphabet (IPA) (1999), there are some allophonic variations in Farsi which are:

1. Two plosive allophones are [q] and [G] of /ɣ/. [G] is an allophone which is used in the initial position of the word, after nasals or in co-articulation position of /ɣ/. [q] is used when it is positioned in the middle of a word between two vowels (intervocalically).
2. A nasal allophone of /n/ which is [ŋ]. It is produced before the production of [k, ɡ, G, x, ɣ].
3. A trill allophone of / ɾ / is [r] is observed at the beginning of the word.

The two velar plosives /k, ɡ/ are palatalized only before the three front vowels /æ, e, i/ for example [pɒcæt] ‘envelope’ or when they are placed at the end of a syllable such as [sæɟ] ‘dog’ (Alamolhoda, 2000).

### 2.10.2.3 Vowels

Farsi has six distinct monophthong vowels which include long vowels /ɒ:/, /i:/, /u:/ in contrast with short vowels /æ/, /e/, /o/.

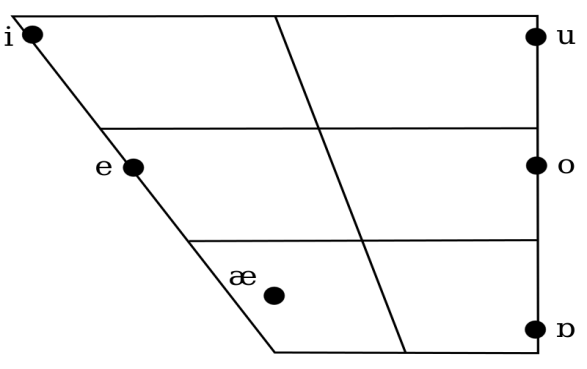


figure 2.5 shows monophthong vowel phonemes in Farsi

The two vowels /æ/ and /o/ are rarely produced at the end of the word. According to several studies (Samareh, 1977; Pisowicz, 1985 and Najafi, 2001) the length of vowels is not a distinctive feature in Farsi. They propose that three vowels /i, u, ɒ/ that are considered as long vowels are distinguished from /æ, e, o/ principally by the position of the tongue, i.e. by vowel quality. The main allophonic feature of vowels is that they are nasalized before nasal consonants (The International Phonetic Association, 1999). Table 2.3 indicates the articulatory positions of vowels in the Farsi language.

Table 2.3 Articulatory positions of the vowels of Farsi

|  |  |  |
| --- | --- | --- |
|  | Front | Back |
| High | /i/ | /u/ |
| Mid | /e/ | /o/ |
| Low | /æ/ | /ɒ/ |

Diphthongs in Farsi include /ej/, /aw/, /ow/, /aj/, /ɒj/, /oj/, and /uj/. Two historical diphthongs /æj/ and /æw/ have been changed to /ej/ and /ow/ respectively in modern Persian, while they are produced without change in some Eastern dialects. Moreover, /ow/ has converted to /o/ in the Tehrani dialect (Najafi, 2001).

### 2.10.2.4 Stress and syllable structure in Farsi

Windfuhr (1979) characterized Farsi as a syllable-timed language. This means that the syllables are pronounced at approximately regular intervals of time. It thus differs from English, which is stress-timed. Mahjani (2003) indicated that occurrence of two vowels in the same syllable in Farsi is impossible because of the phonological restrictions of the language. Thus the number of syllables and vowels are equal (Samareh, 2000). Each Farsi word usually has one to five syllables. The pattern of Farsi syllable structure is CV, CVC or CVCC. Thus the syllable always contains an onset. Some words which may appear to start with vowels are in fact pronounced with a glottal stop as the syllable onset, for example/ʔæbru/ which means ‘eyebrow’ (Hall, 2007). Syllable-initial consonant clusters do not occur in Farsi and syllable-final consonant clusters cannot have more than two consonants (Hall, 2007).

Chodzko (1852), Ferguson (1957), Same’I (1996) and Yarmohammadi (1996) proposed that word stress in Farsi is predominantly on the final syllable. However, this is true only when the dictionary entry form of the word is considered for example, nouns in isolation, or infinitive verbs. If inflected forms of nouns and verbs are included, this statement that word stress is on the final syllable is not true. For example, /raftaˈn/ ‘’to go’’ which is an infinitive is changed to /mīˈraft/ ‘’se/he has gone’’. Sepanta (1976) and Yarmohammadi (1996) pointed out that the feature which gives prominence to the stressed syllable in Farsi is pitch.

### 2.10.2.5 Stress in sentences

According to Ferguson (1957), when Farsi words are pronounced in isolation, it is obvious that one syllable has heavier stress than the others. When the same word is pronounced in a sentence, usually the same syllable is stressed or there is no stressed syllable in this word at all. The stress rarely shifts to another syllable of the word. Ferguson pointed out that in conversational speech over half of the words may not have final stress.

### 2.10.2.6 A brief comparison between Farsi and English

There are some differences in consonantal distribution between these two languages. Yavas (2006) pointed out that there are some consonants such as [θ, ð] in the English language, which are absent in the Farsi language. On the other hand, two fricatives [x] and [ɣ] which do not occur, at least as phonemes, in English, have phonemic status in Farsi. Furthermore, many consonants, which are similar in both of these languages, are different in their production (Hall, 2007). For example, [k] and [ɡ] are voiceless and voiced plosives in English and Farsi, but in Farsi they are produced further forward than velars in English. Another example is the two fricatives [s] and [z] which are produced in the alveolar location in English; in contrast they have dental articulation in Farsi. According to Yavas, (2006), there are eleven or twelve monophthong vowels identified in English, while Farsi has only six monophthong vowels. Another difference in vowels is in relation to length. In English there are three groups of vowels: long monophthongs, short monophthongs and diphthongs. Difference in length in English can contribute, along with difference vowel quality, to changing in meaning (Hall, 2007) whereas the length of vowels in Farsi does not change the meaning.

## 2.11 Speech development in Farsi-speaking children

As is the case with investigations into other aspects of child language, the study of the order of sound acquisition has long focused on English and other European languages. There are just a few studies on speech development in Farsi-speaking children.

### 2.11.1 Vowel and consonant acquisition in Farsi

Geraminejad (1983) conducted a normative study on 8 monolingual Farsi-speaking children aged from 1 to 5;6. She aimed to examine the acquisition of fricatives in the Farsi consonants inventory and vowels in Farsi-speaking children. She proposed that Farsi-speaking children can produce all vowels before they are 19 months old and produce fricative consonants correctly by two years old. This findings are not similar to English (Appendix 1). It leaves some ambiguity, as the author did not provide a clear description why she focused only on fricatives.

In 1992 Rahemi and Salehi examined the speech inventory of 50 typically-developing children aged 3;0 to 6;0. Speech samples were collected using sentence repetition. After data collection, the authors transcribed. The aim of this study was to find normative data for articulation test. They found that although the majority of consonants are articulated correctly by three years old in more than 75% of Farsi-speaking children, production of [ʒ] is more challenging and the target sound may not be achieved until approximately six years old. As the first Farsi articulation test was based on these findings, this study is important. However, it has been noticed that authors used sentences that are difficult to produce for this large age group.

An important study which focused on the developmental phonetic inventory in Farsi-speaking children is that of Damirchi et al. (2010). This was a cross-sectional descriptive study that examined speech samples from 96 Farsi-speaking children aged 2 to 6 years who lived in Tehran. Through 44 pictures, consonants of Farsi were studied in word initial and word final positions of single and bisyllabic words. Spontaneous speech samples were recorded.

The aim of their study was to determine the acquisition age of consonants in Farsi- speaking children. Bilabial consonants /p, b, m/ were the first consonants that were produced accurately by the Farsi-speaking children who were 2 to 2;6 years old. In contrast, the fricative /ʒ/ and affricate /ʤ/ were the last accurate consonants which were observed in the speech of 4 year old Farsi-speaking children. Tables 2.4 and 2.5 reflect the findings, which are consistent with the similar studies done in English language.

A relatively detailed description of speech development in Farsi-speaking children was made by [Jalilehvand (2012](#_ENREF_19)). This study provides data on the patterns of speech development in two Farsi-speaking children, aged between 12 to 60 months. Spontaneous speech samples were recorded and transcribed by an examiner using narrow phonetic transcription. The aim of this study was to determine consonant inventories in the speech of children and frequency of occurrence of consonants. Her findings are in line with previous research carried out by Damirchi et al. (2010).

Table 2.4 summarises the sequence in which children learn the vowels and consonants of Farsi, drawing on the studies reported in this section.

Table 2.4 Order of acquisition of Farsi vowels and consonants in children aged 12-17 months prior to using these sounds for meaningful speech

|  |  |  |
| --- | --- | --- |
|  | | **Order of pre-speech sound acquisition** |
| **Vowels** | | First: [æ] and [i]  Then: [ɒ] and [u]  Finally: [e] and [o] |
| **Consonants** | **Manner of articulation** | Nasal and plosive consonants: [t, d, b, n, k, m]  Fricative, affricate and approximant consonants: [ʧ, h, l]  Trill consonants: [r] |
| **Place of articulation** | Bilabial and alveolar consonants: [b, p, t, d, m, n]  Post alveolar, palatal, velar, uvular: [ʧ, j, k, G]  Glottal and labiodental: [ʔ, f] |

[Jalilehvand (2012](#_ENREF_19)) also provides data on order of consonant acquisition in the speech of children as old as 42 months. There is no information about how she has found this data. Table 2.5 below summarises the order of consonant acquisition by Farsi-speaking children.

Table 2.5 Order of consonant acquisition in children up to 42 months. Reproduced with permission.

|  |  |  |
| --- | --- | --- |
| Table 2.5 Order of consonant acquisition in children up to 42 months | | |
| ***Age*** | ***Consonant*** | ***Example*** |
| 12-17m | /d, t, m, n, ʔ, k, h, p, b, j, l/ | /mɒmɒ/, /næ/ |
| 18-23m | /x, ɡ, ʧ, ʃ, ʤ, s, z/ | /ɡo/, /ʧi/ |
| 24-29m | /f, v, ɾ, G/ | /boɾo/, /Gos/ |
| 36-42m | /ʒ/ | /mæʒik/ |

In general, there is a tendency for nasals, plosives and anterior consonants, such as bilabials and alveolars, to be acquired first, whereas fricatives and sounds typically produced at posterior places, such as velars and uvulars appear to be acquired late. According to Dodd et al. (2003) in appendix 1 this is true in languages in general.

Table 2.6 shows the results of all speech acquisition studies discussed in this section.

Table 2.6 Summary of Farsi speech acquisition studies

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name of the researcher | Participant’s information | Age of the participants | Method | Aim | Result |
| Geraminejad (1983) | 8 monolingual typically developing children who speak Farsi | 1 to 5;6 | ----- | To examine the acquisition of fricatives in the Farsi consonants inventory and vowels | Farsi-speaking children can produce all vowels before they are 19 months old and produce fricative consonants correctly by two years old |
| Rahemi and Salehi (1992) | 50 typically-developing children who speak Farsi | 3;0 to 6;0 | Using sentence repetition as a speech sample | to find normative data for articulation test. | More than 75% of Farsi speaking children produce majority of consonants correctly by three. [ʒ] is the most challenging consonant and might be achieved by six. |
| Damirchi et al. (2010) | 96 typically-developing children | 2;0 to 2;6 | Through 44 pictures, consonants of Farsi were studied in word initial and word final positions of single and bisyllabic words. | to determine the acquisition age of consonants in Farsi- speaking children. | Bilabial consonants /p, b, m/ were the first consonants that were produced accurately. The fricative /ʒ/ and affricate /ʤ/ were the last accurate consonants which were observed in the speech of 4 year old Farsi-speaking children. |
| Jalilehvand (2012) | Two typically-developing children | 12 to 60 months | Spontaneous speech samples | To determine consonant inventories in the speech of children and frequency of occurrence of consonants. | Bilabial consonants /p, b, m/ were the first consonants that were produced accurately. |

### 2.11.2 Phonological processes in Farsi

Although a great number of studies have focused on developmental phonological processes in different languages, few studies have been conducted regarding Farsi. However, valuable insight into this area has been provided by Fahim (1996), and Damirchi (2008). Fahim (1996) reported the development of phonological features attested in the speech of his monolingual Farsi-speaking daughter. The main aim of Fahim’s study was to establish when Farsi-speaking children relate sounds to meaning and to describe the phonological and morphological development of Farsi-speaking children. It was a case study of the child from 7 to 34 months old. He divided the 27 months into five stages: the pre-linguistic stage (7-12 months), single word production stage (12-18 months), multiword production stage (18-24 months), complex multiword production stage (24-30 months) and utterance and sentence production stage (30-34 months). Results showed the occurrence of three main types of phonological processes; substitution processes, assimilation processes and syllable structure processes. Fahim found that plosives /b, p, t, d, k, ɡ/, fricatives /f, v/ and nasals /m, n/ were produced by the child by 34 months old. One of the main weaknesses of Fahim’s study was that the meaningful verbal contexts such as words and phrases were not separated from vocalisations, while most studies suggest that the sounds produced in the pre-linguistic stage should not be included in the early language stage (Ingram, 1996).

One of the most significant studies in this area is that of Damirchi (2008). She studied Ingram’s phonological processes in 20 normally developing Farsi-speaking children between the ages of 2 and 6 years as showed in table 2.7. 44 words included consonants of Farsi were used to elicit the speech sample by picture naming.

Table 2.7 The approximate age of maturation of normal simplification phonological processes in Farsi (Damirchi, 2008)

|  |  |
| --- | --- |
| Phonological processes | Age of elimination |
| Fronting | 2;0-2;6 |
| Initial consonant deletion | 2;0-2;6 |
| Metathesis | 2;0-2;6 |
| Idiosyncratic processes | 2;0-2;6 |
| Affrication | 2;6-3;0 |
| Final consonant deletion | 3;0-3;6 |
| Gliding | 3;0-3;6 |
| Assimilation | 3;6-4;0 |
| Stopping | 3;6-4;0 |
| Deaffrication | 4;0-4;6 |
| Cluster reduction | 4;6-5;0 |

So far, a brief review of the key literature on typical speech development has been presented. An attempt was also made to relate the general speech development patterns with those reported for Farsi-speaking children. Due to a shortage of relevant literature on speech development in Farsi-speaking children, no detailed cross-linguistic comparison could be made. However, a brief comparison between findings of Farsi studies and some English studies such as Dodd et al. (2003) shows that phonemic acquisition in Farsi is generally similar to those reported in English. For example front consonants acquired before back consonants. This finding supported Jackobson’s (1968) theory of universal patterns of acquisition.

The next section is devoted to reviewing studies of speech development in children with cleft palate.

## 2.12 Speech development in children with cleft palate

Prior to palate repair infants have no capacity to distinguish between nasal and oral sounds such that their sound repertoire is restricted to [m, ŋ] and sounds that have no need of intra-oral pressure such as glottal, pharyngeal sounds.

After palatal repair the quality of speech as it develops determines the nature of further treatment. While for a long time there was a lack of studies related to the nature of speech difficulties in individuals with cleft palate (Peterson-Falzone, 1996), the nature of cleft palate speech and the influence of cleft palate on speech quality has become of interest in recent years.

As in typically-developing children, speech development in children with cleft palate is partly governed by normal simplification processes. In common with non-cleft children, children born with cleft palate go through similar developmental stages in terms of speech and language acquisition. However, the rate at which these children reach a certain developmental milestone and the order of speech sounds they acquire may differ from the typical patterns. As noted above, it has been recognised that pre-speech production features used by typically-developing infants during pre-speech vocalisation stages are strongly linked to early and later speech. Likewise, a number of studies on pre-speech vocalisations in children with cleft palate have shown that features frequently reported in cleft palate speech, such as retracted articulatory patterns and compensatory articulations, are often observed in pre-speech vocalisation stages (Chapman *et al.,* 2001; [Salas-Provance *et al.*, 2003](#_ENREF_43); [Scherer *et al.*, 2008](#_ENREF_45)).

### 2.12.1 Pre-speech development

Most of the studies of vocal and early speech development in children with cleft palate compare this with patterns of speech development in typically-developing children. Chapman et al. ([2001](#_ENREF_7)), for instance, compared the pre-speech development of 30 9-month-old children with un-operated cleft palate with that of 15 age-matched typically-developing children. In this study, the infants with cleft palate were found to have smaller canonical ratios (i.e., the number of canonical syllables divided by the total number of syllables) than the non-cleft children. Likewise, Scherer et al. ([2008](#_ENREF_45)) studied the early vocal development of 13 babies with cleft lip and palate at 6 and 12 months of age by comparing them with 13 age-matched typically-developing children. With the exception of one of the babies with cleft lip and palate who received cleft repair surgery at the age of 13 months, all the children had their clefts repaired between 10 to 12 months. The results showed that the two groups of children did not differ at 6 months in terms of vocal development. However, as their pre-speech vocalisations developed, e.g., at 9 months, the cleft group showed a delay in babbling vocalisations. This is in agreement with Chapman et al.’s (2001) findings.

In terms of the size of consonant inventories, some studies (e.g., Scherer, 1999; Chapman *et al*., 2001; Chapman *et al*., 2003) reported that children with cleft palate differed from their non-cleft peers, while other studies (e.g., [Chapman, 1991](#_ENREF_4); [Jones *et al.*, 2003](#_ENREF_20); Scherer *et al*., 2008) found no significant group differences.

The evidence from these studies suggests that while different timings and types of surgery and hearing management can affect speech production of children with cleft palate, there seems to be a significant difference between the development of pre-speech vocalisations in children around 9 months with cleft palate and that of typical children. In this regard, the differences between children with cleft palate and those without cleft are in the complexity of early vocalisations as well as the amount of vocalisation. Thus, the amount and the complexity of early vocalisations are important elements that distinguish children with cleft palate from their non-cleft peers.

### 2.12.2 Transition from prelinguistic stage to later speech

Vocalisation patterns observed in babies with cleft palate in pre-speech stages appear to have some resemblance to speech production features noted in early speech. Russell and Grunwell (1993), for example, reported that lack of plosives and a predominance of nasal articulations were observed during the pre-speech phase, which continued to be seen in a range of consonants produced in early speech as well. This was previously reported by O’Gara and Logemann (1988) who observed that during the pre-linguistic period, infants with cleft palate produced more glottal stops and fricatives than oral or nasal stops and fricatives. The authors also noted that this tendency continues to be seen in later stages. Hence, as the link between the phonetic repertoire of babbling and early speech in cleft palate babies has been established, it is recommended that routine speech and language therapy screening for monitoring babbling development should be carried out at the age of 18 months (Russell & Grunwell, 1993).

A number of other studies also looked into the phonetic characteristics of children with cleft palate during pre-speech and pre-surgery vocalisation phases. In agreement with the research mentioned above, these studies observed that the children concerned produced fewer pressure consonants, particularly oral stops, and also preferred using glottal place features (Chapman, 1991; Chapman *et al*., 2001). These studies show that, generally, children with cleft palate who are at risk of delay in speech development can be identified during this pre-speech phase, when atypical phonetic characteristics start to become apparent.

Due to the challenges related to the cleft condition in producing speech sounds during the pre-speech phase, which as noted above, also impact on later speech development, children with cleft palate are often reported to show delay in speech and language developments, compared to their non-cleft peers. Although many factors (e.g., hearing issues, frequent hospitalisations, effects of past or present fistula, etc.) may contribute to the delay observed in children with cleft palate, their speech development is mainly affected by the atypical structural features caused by the cleft (McWilliams *et al*., 1990). Even after the cleft is surgically repaired and the speech production mechanism affected by the cleft is normalised, atypicalities noted in early speech development in children with cleft palate appear to persist (Scherer *et al*., 2008). This can be exemplified by the occurrences of certain speech production behaviours characteristic of individuals with cleft palate in the pre-linguistic phases of speech development. These include backing and other compensatory articulations. It has also been shown that babies producing more consonants, particularly more oral consonants, in pre-speech vocalisations seem to have better-developed speech and language and demonstrate better language skills at later stages (Chapman *et al*., 2003; Chapman, 2004).

However, since the cleft condition affects most obstruent consonants during early speech development, often, it also significantly influences later speech performance. This has been shown by a number of studies over the years (e.g., Chapman, 1991; Scherer *et al*., 1999). The existing empirical data on the link between pre-speech development and later speech generally shows that the effects of the cleft on pre-speech vocalisations usually influence early word production and later speech performance. This underscores the importance of early intervention for individuals with cleft in order to be able to achieve better speech and language performance later on.

### 2.12.3 Onset of first words and later speech

As noted in the previous section, during pre-linguistic stages, many children with cleft palate demonstrate a number of atypical speech production patterns. These are observed in later speech as well and include having a reduced inventory of speech sounds, limited vocabulary, and the emergence of compensatory articulation patterns (Salas-Provance *et al*., 2003; Scherer *et al*., 2008). The nature of these atypical speech production features observed in later speech have been debated. The central issue here is whether cleft speech characterstics, which have been identified both in pre-linguistic stages as well as in later speech, have phonological consequences.

Mainly before the 1980s, most studies conducted on cleft-related speech categorised cleft speech issues as ‘articulation disorders’. More recent studies (e.g., Chapman, 1993; Harding-Bell & Howard, 2011), however, point out that patterns of cleft-related speech are the product of the children’s response to the effects of the cleft palate interacting with their own phonological development. Such researchers have thus taken a phonological approach to speech issues identified in children with cleft palate. This is due to increased understanding among researchers regarding the connection between articulatory and perceptual constraints and phonological development. Howard ([1993](#_ENREF_17)), for instance, noted that phonetic and phonological dimensions are involved in cleft-related speech difficulties. However, the established practice of approaching speech difficulties related to the cleft mainly from a phonetic viewpoint continues (Chapman & Willadsen, 2011). Since the incomplete articulatory mechanism, caused by the cleft, may have an impact on the development of the phonological system, the phonological aspect of cleft-related speech should not be ignored (e.g., Grunwell, 1987; Chapman & Hardin, 1992; Harding-Bell & Howard, 2011). In the sections that follow, articulatory and phonological features of cleft-related speech will be discussed.

### 2.12.4 The function of the palate in cleft palate speech

Following cleft palate repair between 6-12 months some infants quickly discover new sounds and progress to develop normal or near normal speech. Others continue to have a limited range on sounds particularly if the palate is still not able to separate the oral and nasal cavities. This has an affect on the tone of voice and on the control of airflow during consonant production. In normal speech the soft palate retracts and elevates during normal speech to separate the oral cavity (mouth) from the nasal cavity in order to produce the oral speech sounds. If the VP port fails to direct air orally, air escapes through the nose, causing a disturbance in the balance of oral and nasal resonance during speech. Resonance disorders are most commonly associated with the abnormal function or structure of the velopharyngeal port in the individuals with a cleft palate. *Resonance* refers to the distribution of acoustic energy in the nasal cavity whereas *nasal* *airflow* refers to the amount of air escaping nasally with during speech sounds production. Kummer et al. (1992) stated that when the airflow is not separated between oral and nasal cavity, hypernasality, and mixed nasality will occur. *Hypernasality* refers to perceived excessive nasal resonance, which affects 25-40% of the cleft palate population (Sell *et al.,* 2001). *Hypernasality* occurs due to inadequate closure of the velopharyngeal port during speech or to a fistula in the hard or soft palate. *Hyponasality/denasality* refers to a perceived decrease of resonance in the nasal cavity, due to partial or complete obstruction of the nasal passage or nasopharynx. *Mixed resonance* refers to the occurrence of both hypernasality and hyponasality in the speech of a single individual with a cleft palate. This pattern is sometimes encountered in individuals with cleft palate who have a pharyngeal flap or prosthetic devices.

### 2.12.5 Articulatory characteristics

Speech production patterns associated with cleft palate have been researched at length. These studies have examined speech production features associated with articulation, resonance, nasal airflow and voice.

It has been established that atypical articulation is one of the main features that characterise cleft-related speech. Hence, features such as nasal emission, nasal resonance and compensatory articulations commonly characterise cleft-related speech in different languages (In English: Harding & Grunwell, 1998; In Amharic: Mekonnen, 2013; in Arabic: Al-awaji, 2014). Although the above mentioned speech production features are generally attested in individuals with cleft palate, there are a number of other factors that make these individuals different from each other. These factors include the type and severity of cleft, whether or not the cleft is repaired, the time at which the cleft is repaired and whether or not syndromic complications exist. Due to these differences, speech output can differ from one child with cleft palate to the next (Albery & Grunwell, [1993](#_ENREF_1)).

Consonants such as oral plosives (e.g., /p, b, d, etc./), fricatives (e.g., /f, v, s, ʃ, etc./) and affricates (e.g., /ʧ, ʤ, etc./) are vulnerable to atypical production as a result of the problems with palate function. This is because these obstruent consonants, often referred to in the cleft literature as ‘pressure consonants’, require a build-up of air-pressure within the oral cavity, which in turn requires the closure of the velopharyngeal port. Often this is not the case in individuals with cleft palate after the palate is surgically repaired (Peterson-Falzone *et al*., [2001](#_ENREF_35); Peterson-Falzone *et al*., [2006](#_ENREF_36)). Other consonants such as nasals and liquids are rarely affected by the cleft condition (Harding & Grunwell, 1996, 1998a; Sell *et al*., 1994, 1999; Henningsson *et al.*, [2008](#_ENREF_16)). Harding & Grunwell (1996) discuss the major consonantal characteristics observed or reported from their data or literature in individuals with cleft palate as lateralisation/lateral articulation, dentalisation, palatalisation/palatal articulation, active nasal fricatives, glottal articulation, absent pressure consonants and gliding of fricatives/affricates. As the notion of characteristics of cleft palate speech is central to this research, these will be described at length in chapter 4.

Although many of these atypical speech production features are caused by the cleft, other complications resulting from the condition such as hearing impairment and poor maxillary growth may also lead to cleft-related realisations. In addition, some realisations are the result of a child’s attempt to compensate for the effects of the structural and functional anomalies caused by the cleft condition. These so-called *compensatory articulations* ([Morley, 1970](#_ENREF_26); [Trost, 1981](#_ENREF_54); [Persson *et al.*, 2003](#_ENREF_34); Hardin-Jones & Jones, [2005](#_ENREF_13)) include using a, backed realisations, double articulations, lateralised articulations and glottal articulation ([Trost-Cardamone, 1990](#_ENREF_55), [1997](#_ENREF_56); Hardin-Jones & Jones, 2005; [Russell, 2010](#_ENREF_42)).

It is important to note that many of the above-mentioned compensatory articulatory behaviours seem to be the result of an attempt by the speaker to signal phonological contrasts, while some of these compensatory strategies have phonological consequences (Harding & Grunwell, 1996; Harding-Bell & Howard, 2011), which will be discussed in the following section.

### 2.12.6 Phonological consequences of cleft palate

Compared to the research describing the articulatory effects of the cleft condition, there are not many studies dealing with its effects on phonology. Phonological development might be affected as a result of articulatory contraints imposed by the structural abnormality. It might affect the child’s ability to signal phonological contrasts that are essential for meaningful speech. Structural abnormality in the speech mechanism presents a physical challenge in producing specific sounds in any language, which can limit the range of sound contrasts available to a child. This inability to signal meaningful differences in the language results in a phonological disorder. According to some studies, the phonological problems in children with a cleft palate occur because of the difficulty in organising the sound system within a language (Chapman, 1993), while other studies suggest that these types of problems in the speech of children with a cleft palate are part of an overall delay in expressive language which is common with this population (D’Antonio & Scherer, 1995; Morris & Ozanne, 2003; D’Antonio & Scherer, 2008). Chapman and Hardin (1992) suggested that some of the phonological processes that are identified in the speech of children with a cleft palate are directly related to the palatal cleft whereas others are typical phonological development. Harding and Howard (2011) stated that phonological processes that are considered as typical phonological development are likely to persist for a longer period in children with a cleft palate compared to typically-developing children. Chapman (1993) stated that following palatal repair, errors might be persistent because the child has adopted a rule such as, substituting velar stops for bilabial and alveolar obstruents. Therefore, palatal repair in the first six to nine months of age is important. This reduces the risk of children developing atypical articulatory preferences in babble, which might influence speech development.

The effects of the cleft palate on the phonological system can be demonstrated by the following example: if a child speaking a language such as English or Farsi that has /t/ and /d/ as contrastive phonemes, realises both /t/ and /d/ as [t͋], then this child is not able to signal the phonemic contrast that exists between the two phonemes. In addition, due to reduced intra-oral pressure and increased nasal resonance, individuals with cleft palate may realise /b d ɡ/ as [m n ŋ]. This realisation of voiced plosives as nasals has a serious impact on the phonological system in cases where the phonological system of the language contrasts oral and nasal consonants at the same place of articulation, as happens in Farsi and English. Similarly, the other compensatory realisations discussed above may lead to a loss of contrast between various contrastive phonemes, for instance the backed realisation of /t/ as [k] or /d/ as [ɡ] in a language like English where velar and alveolar articulations are phonologically contrastive.

It has been shown that children with cleft palate differ from their non-cleft peers in early phonological development. Studies have reported delayed and atypical phonological processes linked to cleft palate (Chapman & Hardin, 1992; Harding & Grunwell, 1995; Salas-Provance *et al*., 2003). Phonological patterns reported for individuals with cleft palate include stopping, backing, deletions of final consonants, syllable reduction, initial consonant deletion, nasalization, velar assimilation, glottal insertion, nasal assimilation and nasal preference (in English:Chapman, 1993; Morris & Ozanne, 2003; in Amharic: Mekonnen, 2013; in Arabic: Al-awaji, 2014).

It can be concluded then that the phonological processes reported in studies of cleft palate speech include most of the patterns found in normally-developing children, but these processes might be more common and more persistent in the speech of children with a cleft palate (Harding & Howard, 2011). On this point McWilliams et al. (1990) proposed that the most common phonological processes in the speech of typically-developing children were weak syllable deletion, final consonant deletion, cluster reduction, liquid simplification, assimilation, velar or palatal fronting, and stopping fricative. These are also the most common processes in the cleft palate population.

## 2.13 Summary

In this chapter, a number of topics have been reviewed. Early stages of speech and language development have been described. The connection between early vocalisations and later speech in children with cleft palate in contrast with typically-developing children has also been discussed. The phonetics and phonology of Farsi has been reviewed in this chapter. Consonants and and their allophonic variants, vowels, stress patterns and syllable structure were described. Moreover, a brief comparison between Farsi and English was provided. In addition, the main articulatory and phonological features of cleft-related speech production in children with cleft palate have also been highlighted. The review has shown that in typical speech development as well as in the development of cleft-related speech, early vocalisations and later speech are connected in the sense that later speech is a continuation of early pre-linguistic vocalisations. It has become apparent from the literature reviewed that both in typically-developing children and children with cleft palate, aspects of early and later speech can be predicted from aspects of early vocalisations. Moreover, in this chapter, it has been shown that the articulatory behaviours noted in individuals with cleft palate are mainly the result of the structural and functional deficits caused by the cleft condition. These articulatory issues go beyond articulation, that is, they also affect the phonological system. In the next chapter, matters relating to the assessment of patterns of speech production associated with cleft palate will be considered.

# Chapter 3 Assessment of cleft palate speech

## 3.1 Introduction

This chapter reviews the literature on the assessment of speech production, focusing on the assessment of cleft palate speech. As will be discussed below, researchers and clinicians use perceptual and instrumental analysis to deal with speech data in clinical contexts or for research purposes. Since this study exclusively uses perceptual analysis, a detailed account of instrumental analysis of speech production will not be made. Instead, this review focuses on the use of various perceptual analyses in the assessment of cleft-related speech in particular. The chapter describes and critically reviews the advantages and disadvantages of the existing perceptual speech assessment and analysis methods being used.

## 3.2 Historical overview of cleft palate speech assessments

In the 1970s, speech therapists supposed that because of significant development and refinements in surgical techniques, cleft palate patients would no longer require speech therapy, so in the 1980s, speech therapists concentrated more on speech outcome evaluation after surgical intervention (Sell, 2005). The result of this was the devising of different methods for cleft speech assessment; for example, Copeland (1990) assessed nasal resonance, nasal emission and intelligibility using a linear analogue scale.

There were few published descriptions of speech assessments in the 1970s and 1980s since most of the journals publishing papers on cleft speech assessment were surgical journals. Surgeons needed speech therapists to report speech results in a systematic way because they wanted to use SLTs reports of the quality of speech as a measure of the results of surgical intervention, so that they could compare outcomes. Although speech therapists were able to recognise the features of cleft palate speech and the errors related to it (Sell, 2005), the development of a tool for measuring speech outcomes was a prolonged process.

Several authors, such as, Dalston et al. (1998), suggested more detailed assessments of articulation and resonance to distinguish between errors which are related to cleft palate, and those which are not. In the 1990s, there was increasing emphasis on investigating speech outcomes to compare different surgical procedures (Brothers *et al*., 1995; Haapanen, 1995; Lohmander- Agerskov, 1998; Williams *et al*., 1998). In the 2000s, clinicians tended to use generic speech tests and protocols such as the Screening Test of Articulation (Templin & Darley, 1960). Although these tests can provide information on cleft palate speech, many experts preferred to use specialist speech sampling and assessment procedures (Trost-Cardamone & Bernthal, 1993; Peterson-Falzone *et al*., 2001). Articulation tests that were specifically designed for cleft palate speech include the Iowa Pressure Articulation (IPAT) (Morris, 1979), Bzoch’s (1997) clinical test battery and the GOS.SP.ASS.’98 (Great Ormond Street Speech Assessment) (Sell *et al*., 1999). The last of these provided the basis for the Cleft Audit Protocol for Speech (CAPS) (Harding *et al*., 1997) which was approved for be use in inter-centre audit studies of cleft palate speech in the U.K. It was revised and renamed Cleft Audit Protocol for Speech-Augmented (CAPS-A) (John *et al*., 2006). Because these materials focused specifically on eliciting cleft-related speech errors, they provided a more clinically-efficient sampling protocol that could be used with other standardised tests.

A lack of appropriate frameworks to assess the speech of individuals with cleft palate has led to a number of cross-linguistic and language-specific initiatives to develop standardised procedures. Devising an international protocol for assessing cleft palate speech was one of the main goals in the seventh congress on cleft palate and related craniofacial anomalies convened in 1993. In a similar way, various propositions were suggested for standardising speech procedures in the 9th International Congress on Cleft Palate and Related Cranofacial Anomalies 2001 (Lohmander & Olsson, 2004; Sell, 2005). Four speech assessment procedures were presented in that congress: GOS.SP.ASS, the Japanese system for cleft palate speech assessment, the perceptual system used in the United States (American Cleft Palate-Craniofacial Association, 1993) and Cross Linguistic Outcome Comparison (CLOC) (Hutters & Henningson, 2001). Regarding the choice of cleft speech assessment protocol, the Eurocleft Speech Group (1994, 2000) focused on a cross-linguistic phonetic analysis of speech sounds in the speech of children with cleft palate.

Table 3.1 shows the different features of the available published cleft palate speech assessment procedures:

1. GOS.SP.ASS’98: Sell et al. (1999) developed the GOS.SP.ASS framework for cleft speech assessment. While it is introduced as a comprehensive and standardised approach, it is not scientifically standardised to specific population groups. The purpose in developing the assessment was to provide a structured and replicable assessment from which clinical decisions could be derived for use in UK cleft centres. Its particular strength is that it is the only cleft-specific speech assessment to be developed, used and adapted worldwide. Another strength is that it has been used clinically and for research for over two decades and remains relevant and appropriate. Moreover, it has been adapted for a number of different languages and therefore facilitates cross-linguistic comparison. A modified version of this protocol was chosen for this study as a cleft palate speech assessment protocol. The description of this procedure will be provided in chapter 4.

2. CAPS-A: This assessment collects the same speech sample as GOS.SP.ASS but the results are derived from a much more structured analysis protocol involving focused listening by a panel of listeners. Harding et al. (1997) developed the Cleft Audit Protocol for Speech (CAPS), which was subsequently revised and tested for reliability and republished as CAPS-A (John *et al.,* 2006). It was approved for use in inter-centre audit studies of cleft palate speech in the UK. Because these materials focused specifically on eliciting cleft-related speech errors, they provided a more clinically efficient sampling protocol that could be used with other standardised tests.

3. Universal parameters: More recently, Henningsson and colleagues proposed a universal system in order to report the assessment of cleft speech outcomes (Henningsson *et al*., 2008). This system was based on the work of six individuals from different countries who were experienced in cleft speech and who formed a group at the American Cleft Palate-Cranofacial Association annual meeting in 2002. It is designed to facilitate cross-linguistic comparison and bring together protocols used in different languages in different countries.

Although these studies attempt to address the range of issues that are involved in the assessment of cleft palate speech, a comparison of the results presents many variations from clinic to clinic, and most of these approaches have not been fully evaluated for their reliability.

Table 3.1 Available published cleft speech assessment procedures

|  |  |  |  |
| --- | --- | --- | --- |
| Centre and Author | Year of study | Speech sample elicitation | Interpretation of data |
| **London**  **Great Ormond Street Hospital**  **(Sell *et al.,*)** | 1999 | GOS.SP.ASS sentence repetition (20 sentences) | 1) Hypernasality scale: 0-3 and its consistency scale: consistent or inconsistent  2) Hyponasality scale: 0-2 and its consistency scale: consistent or inconsistent  3) Mixed resonance: cul de sac  4) Nasal emission scale: 0-2, its consistency scale: consistent or inconsistent, audibility scale: inaudible or audible and accompanying or replacing consonants  5) Nasal turbulence scale: 0-2 and its consistency scale: consistent or inconsistent, and accompanying or replacing consonants  6) Grimace scale:0-3 and its consistency scale: consistent or inconsistent  7) Consonant production  8) Cleft-type characteristics  9) Developmental errors |
| **CAPS-A**  **(John *et al.,*)** | 2006 | GOS.SP.ASS sentences repetition (20 sentences) | 1) Intelligibility scale:0-4  2) Voice scale:0-1  3) Resonance: Hypernasality scale:0-4 Hyponasality scale:0-2  4) Nasal airflow: Audible nasal emission scale:0-2 Nasal turbulence scale:0-2  5) Grimace scale:0-1  6) Consonant production  7) Cleft type characteristics |
| **Universal Parameters**  **( Henningsson *et al.,*)** | 2008 | Single words, sentence repetition, conversational speech | 1) Hypernasality  2) Hyponasality  3) Audible nasal air emission and/or nasal turbulence  4) Consonants production errors  5) Voice disorder  6) Speech understandability  7) Speech acceptability |

This review shows that researchers and clinicians have been interested in developing and designing cleft speech assessment procedures with national and international applicability. These types of procedure play an important role in cleft lip and palate management. In addition, these formal assessments make it possible to compare individuals with a repaired cleft palate, to assess progress of the individual in therapy, and to compare outcome across different centres, as well as providing a focus for the training of specialists in cleft speech. They can also be used to collect data for research purposes. Moreover, adapting cleft speech assessments for different languages helps to make comparisons across languages and, thus, between centres in different countries. The last point will be returned to later in chapter 9.

## 3.3 Perceptual analysis of speech production

In this section, the main perceptual speech assessment techniques used in the assessment of speech production behaviours associated with cleft lip and palate are reviewed for centuries people have been describing various aspects of speech production mainly by listening to phonetic details. Analysing speech production behaviours largely based on visual and auditory information is known as perceptual analysis. What is seen and heard can vary from listener to listener. In other words, information received through sense organs is generally subjective and therefore it is very difficult to have a constant metric to measure perceptual data. Perceptual analysis is used in various fields such as health psychology to measure pain and happiness, for example or in music to determine notes and pitch scales. In speech sciences, perceptual analysis has been used to describe (qualitatively) consonant and vowel productions, resonance features, vocalic properties, and speech intelligibility.

Before embarking on discussion of the uses of perceptual analysis in examining various aspects of speech production, one may wonder why people still tend use perceptual analysis of speech production, especially in the clinical environment (Sell, [2005](#_ENREF_32); Howard & Heselwood, 2011), whilst there are other technologically advanced techniques that yield more objective results. The reason is that people produce speech in order to communicate and communication is dependent on what people hear and see rather than on the signals that can be recorded by an electronic instrument. Therefore, human perception is an optimal source of information for a clinician to judge the degree of speech difficulty and the effects it has on communication. In other words, although parameters of atypical speech can be measured by instruments, from the perspective of communication a speech difficulty does not exist until (and unless) it is detected by people (Kuehn, [1982](#_ENREF_23)); atypical features may be present but not big enough for listeners to recognise. In the following section, some approaches to perceptual speech assessment will be discussed.

There are several factors that determine the types of perceptual assessment to be used. One factor is the aspect of the speech to be assessed: for example, articulation, airflow, resonance or intelligibility. Another factor is the purpose of the assessment - whether for research, audit or clinical purposes. Depending on whether the aspect of speech to be assessed is segmental realisations (consonants and vowels), or resonance, or intelligibility; or whether the goal of the analysis is to report on atypical speech production behaviours in a journal article or make clinical record and plan interventions, then analysis of the perceptual assessment can be done using either some sort of rating scale or phonetic transcription with or without supplementary instrumental assessment (Howard, [2011](#_ENREF_21)).

### 3.3.1 Rating scales

Perceptual rating scales used for assessing cleft palate speech involve measuring the quality and/or severity of aspects of speech production such as airflow, resonance, intelligibility and even articulation (e.g., Sweeney & Sell, 2008). Thus, for example, resonance quality may be described as *mild*, *moderate* or *severe*. This kind of perceptual rating method is known as descriptive category judgements. Another scaling method is equal-appearing interval scaling (EAI), where the scale has a zero point (which is an arbitrary point) to start with, and further numbers are assigned at equal appearing gaps. So, listeners assign a number corresponding to an interval on the scale to the aspect of speech being investigated. The equal appearing interval (EAI) scale is a type of category scale that is commonly used in studies of speech and resonance (e.g., Dalston *et al.,* 1991; Hardin *et al.,* 1992).

Another scale is direct magnitude estimation (DME), which can be applied with or without a standard speech sample serving as a reference. The standard speech sample is assigned by the investigator, i.e., a number is assigned to a speech sample based on which other ratings will be made. Raters are requested to rate speech data such as consonant production in relation to the standard speech sample. Direct magnitude estimation (DME) is a commonly used ratio scale (e.g., Schiavetti *et al.,* 1994; Eadie and Doyle, 2002). Whitehill et al. (2002) had listener’s rate human speech using three rating scales. The speakers were hypernasal patients with a history of cleft lip/palate. All listeners rated the speech samples using a seven-point EAI scale. Then, one-half of the listeners rated the samples using a DME scale without modulus, and one-half rated the samples using a DME scale with modulus.

Yet another perceptual scaling method is visual analogue scaling (VAS). Copeland (1990) used VAS in the investigation of intelligibility in 100 speakers with a cleft palate. In this procedure, there is a straight line having predefined extremes of attributes to be rated (see the figure below). Then, raters are asked to place a mark on the scale, in proportion to the perceived severity of aspect of speech such as resonance, intelligibility.

|  |
| --- |
|  |
| Pictorial representation of visual analogue scaling |

figure 3.1 Pictorial representation of visual analogue scaling

The VAS demonstrated in the illustration above, can be used to rate the magnitude of disordered airflow, resonance, intelligibility nasal emission, facial grimace, and phonation, where the degree of severity may range along a continuumfrom *normal* to *severe*.

The types of rating scales described above are the most common procedures used in perceptual rating analysis. Various scholars have different positions as to what is the optimal procedure to assess which attribute of speech. This is owing to the fact that the selection of a rating scale is mainly dependent on factors such as the attributes of the speech production to be measured, or the kind of data analysis method one wants to employ (i.e., quantitative vs. qualitative). For instance, since the size between intervals in EAI scale may not actually be equal in all continua, some authors (e.g., [Maier *et al.*, 2010](#_ENREF_28)) prefer VAS over EAI scales for studies involving quantitative analysis.

Although rating scales, as noted above, are used to evaluate various speech parameters (i.e., airflow, resonance, grimace, intelligibility and even overall articulation performance), it is important to get specific information regarding the production and realisation of individual consonants or patterns of segmental articulations and realisations (Sell & Grunwell, 2001). Without detailed information about segmental realisations, then it would be difficult to monitor, using perceptual rating scales, outcomes of an articulatory therapy intervention. These limitations of rating scales can be avoided by using another approach to perceptual analysis of speech production, that is, using phonetic transcription, which will be discussed in some detail.

### 3.3.2 Phonetic transcription

Phonetic transcription refers to the use of a system of letters or symbols to represent information relating to the production and perception of speech sounds. It is a method commonly used in the assessment and analysis of data, next to perceptual rating scales (Howard, 2011). This is particularly true in clinical contexts.

The reasons for using phonetic transcription are twofold. Firstly, ordinary writing systems are insufficient for capturing phonetic details and hence are not that useful for speech assessment and analysis ([Ball, 2006](#_ENREF_5)). For example, speakers with cleft palate typically realise /s/ as [n̥͋] which does not exist in the English writing system. Secondly, as phonetic symbols are generally international, anyone who knows the international phonetic alphabets and symbols can read whatever is written in the system. Thus phonetic transcription, as a vital clinical and research tool, has been widely recognised and used for speech assessment, analysis, interpretation, decision-making, and dissemination of clinical as well as research outputs (Lohmander & Olsson, 2004; Sell, 2005; [Howard, 2011](#_ENREF_21)).

There are many different types and levels of transcriptions that linguists and clinicians use for various purposes. Because of the orientation of the present study, that is to investigate cleft-related speech primarily from a clinical perspective rather than as a theoretical phonetic or phonological study, detailed accounts of the various types and levels of transcriptions will not be provided. However it is important to briefly discuss the types and levels of transcriptions relevant to this study.

### 3.3.2.1 Types of transcription

An important distinction among transcriptions types is that between phonetic and phonemic transcription. In a phonemictranscription, which contains the minimum amount of phonetic detail sufficient to make distinction between phonemes, information regarding various realisations of the same phoneme is not included. A phonetic transcription, however, contains as much articulatory and perceptual details as is required for the transcriber’s purpose ([Ladefoged, 2001](#_ENREF_25)). In clinical contexts, in order to account for realisations that are not commonly observed in typical speech production, it is necessary to use a narrow phonetic transcription that is not restricted to the symbols used for recording allophonic differences seen only in typical speech (e.g., [Ball *et al.*, 1996](#_ENREF_11); [Ball & Kent, 1997](#_ENREF_8); [Ball & Müller, 2006](#_ENREF_9))

### 3.3.2.2 Tools for transcription

The International Phonetic Alphabet (IPA), the latest version of which came out in 2005, is one of the most popular transcription systems. It has been used by linguists and other professionals (e.g. language teachers and lexicographers) to record the segmental and prosodic features of speech. However, the IPA was developed as a way of documenting typical speech production in all languages (International Phonetic Association, 1999). Because of this, it does not attempt to capture all variants of atypical speech behaviours. The need to transcribe atypical as well as typical speech led experts in the area ([Ball, 1988](#_ENREF_3), [1991](#_ENREF_4); Duckworth *et al.*, [1990](#_ENREF_16); [Bernhardt & Ball, 1993](#_ENREF_12); [Ball *et al.*, 1994](#_ENREF_6)) to expand this transcription system so that it accommodates developmental and atypical speech production features. This effort yielded a system called Extensions to the International Phonetic Alphabet (ExtIPA), an IPA/Latin-alphabet-based system, which is commonly used for research and clinical purposes. ExtIPA was last revised in 2015.

Following ExtIPA, another system was introduced which is called Voice Quality Symbols (VoQS System), which is used to transcribe various voice and laryngeal qualities. For example, voice phonation qualities that can be recorded using this system include: whisper, creak, and ventricular voice. Supralaryngeal settings, which occur in longer aspects of speech than individual vowel and consonants, can also be transcribed using this system. These include palatalised, nasalized and velarized settings ([Ball *et al.*, 1999](#_ENREF_7); [Ball & Rahilly, 2002](#_ENREF_10)). Detailed appraisal of various types of transcriptions, notation systems and conventions together with a critical discussion of their merits and demerits from a clinical perspective can be found in Heselwood and Howard ([2008](#_ENREF_20)) and Howard ([2011](#_ENREF_21)).

### 3.3.2.3 What and how much to transcribe

Again, the question of what and how much data should be elicited is determined mainly by the purpose of the analysis. However, a review of the literature reveals that setting the aim of the analysis does not automatically define the type and amount of data required for the set purpose. For clinical analysis, various types and amounts of data have been suggested by different researchers and clinicians. Even though there is no standard guideline as to what and how much data one needs to gather to do clinical analysis, there is also a general agreement in the literature that the more detailed and all-inclusive the speech sample is, the easier it is for the clinician to assess the frequency and consistency of atypical realisations in various contexts, i.e. different word/sentence positions and elicitation modes. In reality, however, clinicians mostly base their analysis on single words. The speech samples are often elicited using picture naming tasks ([Grunwell, 1993](#_ENREF_17); Sell *et al*., 1999; [Kuehn & Moller, 2000](#_ENREF_24) [Henningsson *et al.*, 2008](#_ENREF_19)). In the case of unintelligible speech, eliciting single words (whose glosses are known) makes it easier for clinicians to understand what the target word is, which is not the case when it comes to spontaneous speech, as the clinicians may not understand what the speaker is saying ([Heselwood & Howard, 2008](#_ENREF_20)). However, it is possible to use a sentence repetition task, which enables the transcriber to evaluate speech productions in a connected speech condition. This approach, in addition to eliciting a single word speech sample, has also been advocated by some researchers for clinical settings (e.g., Lohmander & Olsson, 2004; Henningsson *et al*., 2008).

How much data to sample is also the subject of debate in the literature. Some (e.g. Crary,[1983](#_ENREF_15)) suggest that 50 words is sufficient to evaluate a child’s day-to-day phonology, while others e.g., Grunwell (1987) and Lambert and Waters ([1989](#_ENREF_27)) note that 50 words may not be representative of an individual’s speech and are therefore not adequate for a thorough clinical examination. So the analyst should sample a set of at least 50 words and also sample speech in more than one context such as spontaneous speech, single word naming and sentence repetition.

### 3.3.2.4 How to transcribe?

The condition in which transcription is made (i.e., the medium used), the method used to write transcriptions, and the amount of detail that is recorded using transcription are among the most important factors that need to be considered when using transcription both for research and clinical purposes. Phoneticians have long been highlighting the need to use a recording instrument, as (a) it is not practically possible for humans to transcribe speech as fast as natural speech flow, and (b) the recorded data would serve as a documentation of the speech being recorded, which can be used in later analysis. With the advancement of technology, it has become possible to use digital video recordings as an alternative to audio only for research and clinical uses. As a result, it has become very important, and in some cases prerequisite, to make digital video recordings with digital audio as a basis for phonetic and phonological analysis. Such recordings can serve as references against which live transcriptions are validated, or as a basis for later detailed transcriptions after the data is gathered ([Heselwood & Howard, 2008](#_ENREF_20)). Sometimes acquiring audio or video data may not be possible for some reason (e.g., when participants may not be happy to be recorded). In compensation for the resulting disadvantages, transcribing as the speaker speaks provides a number advantages ([Harding & Grunwell, 1998](#_ENREF_18)). For example, silent articulatory features (e.g., very subtle co-articulations, or audible nasal emission in cleft speech), which might not be apparent from either audio or sometimes even video recordings, can be captured in live transcriptions. However, this does not mean that live transcription is without limitations. Obviously, the reason people have sought media such as video and audio is to fill the gap created by live transcription. As indicated above, it is humanly impossible to transcribe spontaneous fast-moving human speech particularly if narrow transcription is the goal. ([Amorosa *et al.*, 1985](#_ENREF_1)). Even if the speakers were to speak so slowly and repeatedly that we can make transcription, it has been recognised in the literature that humans cannot produce the same pronunciations twice, and hence proving or disproving initial perceptions based on repeated or subsequent utterances of the same target can be challenging ([Ladefoged, 2005](#_ENREF_26); Heselwood & Howard, 2008). Thus, high-quality audio with video has become a necessity rather than a choice in analysing speech.

Having decided the medium of recording, and having recorded what needs to be recorded, the number of times the transcriber has to watch and/or listen to the recorded material should also be decided. Some scholars (e.g., Amorosa *et al*., [1985](#_ENREF_1)) suggest that, when transcribing the recorded date, the transcriber can listen to the recording as many times as necessary, while others (e.g., Shriberg & Kwiatkowski, [1980](#_ENREF_33); Shriberg *et al*., [1984](#_ENREF_34)) do not agree with this. The latter scholars instead suggest that transcribers are better not listening to recordings more than three times in order to avoid too much sensory exposure, which can lead to auditory illusions, which in turn may result in unreliable transcriptions. Heselwood and Howard (2008), underlining the negative effect of auditory illusion resulting from too many repeated listening, suggest the use of a technique known as analytical listening, proposed Ashby et al. ([1996](#_ENREF_2)). Analytical listening allows the transcriber to concentrate on a certain speech production feature and listen to it many times.

### 3.3.2.5 Limitations of phonetic transcription

One of the most cited drawbacks of phonetic transcription is that the fact that it is subjective: two people may transcribe the same utterance in two different ways, with varying amounts of phonetic detail or they might also perceive the same utterance differently. However, this is not the only limitation of phonetic transcriptions. Phenomena called categorical perception and phonemic false evaluation ([Buckingham & Yule, 1987](#_ENREF_14)) also contribute to the limitations of transcription. Transcribers tend to disregard speech features not required for phonemic categorisation and assign speech sounds to the closest phonological category in their language. For example, someone who speaks a language which has [ɒ] and [ӕ] as contrastive vowel phonemes, might hear and categorise the vowels differently. However, if [ӕ] is presented to someone who speaks a language which has [e] and [a] but not [ӕ], they might perceive and categorise them as either [e] or [ɒ]. Such a mistaken placement of speech segments into a listener’s own internalized phonemic categories, due to the effect of categorical perception, is what is known as phonemic false evaluation. It has been reported (e.g., [Trost, 1981](#_ENREF_35)) that such misperception often happens, for example, when English listeners judge the mid-dorsum palatal stops often encountered in cleft-related speech. Some listeners categorise these sounds as either /t/, /d/ and /n/ or /k/, /ɡ/ and /ŋ/, i.e. they assign the palatal stop to one or other of the two adjacent phonemic place categories for English stops: alveolar or velar.

Another limitation of phonetic transcription relates to the transcription of children’s undeveloped speech or unusual atypical speech production patterns. As has been indicated above, the ExtIPA has been developed to capture speech production features that cannot be recorded only by using IPA. There might be phonetic features in children’s speech or in some unusual atypical speech disorders, which might not be captured even with ExtIPA symbols. For example, sometimes children produce immature realisations, which are not distinct enough for an unfamiliar listener to detect, but which are distinctive to familiar listeners. Such realisations may result in so-called covert contrasts ([Scobbie *et al.*, 1998](#_ENREF_30), [2001](#_ENREF_31); [Berti, 2010](#_ENREF_13); [Munson *et al.*, 2010](#_ENREF_29)). Moreover, the listener’s prior knowledge and expectations can also affect the validity of phonetic transcription, which needs to be considered. Nevertheless, even though phonetic transcription has these limitations, it has been, and continues to be, one of the most important tools in clinical and research settings, when dealing with human communication.

## 3.4 Reliability

In general, reliability relates to precision in measurement, especially when a test or measurement is applied as part of the data collection process. It is defined as the reproducibility of a measurement. Joppe (2000) stated that when the results of a study can be reproduced under a similar methodology, the research instrument is considered to be reliable. She stated that poor reliability reduces the possibility of tracking changes in measurements in the clinic or in experimental studies.

Kirk and Miller (1986) identified three types of reliability of data:

1. *Test-Retest reliability* refers to the test’s consistency with different administrations. To obtain a coefficient for this type of reliability, the same test is completed by a group of subjects on at least two separate occasions.

2. *Parallel forms reliability* uses different pre- and post-tests. They must be parallel or equal in what they measure. To determine the reliability of parallel forms, a reliability coefficient is calculated on the scores of the two measures taken by the same group of subjects.

3. *Inter-rater reliability* is established by having two or more observers rate the same data and then by correlating their observations.

Muller et al. (2006) stated that most analysis in the study of human communication involves the observation of spoken language and so relies on some form of transcription. In general, phonetic transcription is used in the research of different aspects of speech communication in different fields, such as language acquisition and clinical linguistics. Whenever observations of behaviour are used as data in research, we want to be sure that these observations are reliable.

### 3.4.1 Reliability of phonetic transcription

Shriberg and his colleagues (1984) stated that the quality of phonetic transcription needs to be checked in speech communication studies. Analysis of inter-rater reliability between two independent transcribers is the most frequent procedure used to examine the quality of phonetic transcription. This procedure only provides reliability of phonetic transcription within the chosen particular transcription system for these two listeners (Shriberg & Lof, 1991).

Achieving optimal reliability of phonetic transcription is challenging, and therefore researchers and clinicians tend to report estimates of transcription reliability. Despite its challenges, Cucchiarini (1996) stated that measuring the reliability of phonetic transcription in the speech therapy field is essential because the transcribed data are used in speech assessment, therapy and are also used to evaluate the efficacy of therapy. In contrast, Ramsdell et al. (2007) contended that agreement of transcribers cannot guarantee that the phonetic transcription is accurate. Many researchers such as Kuehn and Moller (2000), Gooch et al. (2001), Lohmander and Olsson (2004), and Sell (2005) emphasise the need for standardised methods and for more detailed reports on methodologies used in speech assessment.

### 3.4.2 Methodological approaches in evaluation of transcription reliability of cleft palate speech

There are many factors that influence the results of cleft palate speech evaluation. Therefore, finding the best methods to collect and analyse the cleft speech data is important. Standardised methods require collecting and analysing cleft speech data in a valid and reliable way. One of the most common methods for assessing cleft palate speech has been the interval rating scale (Lohmander & Olsson, 2004), although phonetic transcription has become more popular in this area (Chapman & Hardin 1992; Morris & Ozanne 2003; Chapman *et al.,* 2008; Lohmander & Persson 2008). Heselwood and Howard (2008) indicated that one of the advantages of phonetic transcription is that it is possible to analyse the separate units of speech in a linear sequence as well as identifying and categorising the aspects of speech that need more focus.

There are several considerations that inform the choice of speech sample, transcription conventions and analysis method:

1. *Broad transcription to achieve high agreement, or narrow transcription with a risk of poor agreement.*

According to Shriberg and Lof (1991) and Brøndsted et al. (1994), low transcriber agreement is seen in severe speech disorders, where broad phonetic transcription is more reliable than narrow. However, narrow transcription is preferable for most purposes as it aims to identify precisely the speech sounds that the speaker is using (Heselwood & Howard, 2008).

1. *Selection of listeners*

Level of the listener knowledge, skills in transcription and the amount of experience working on similar data are important factors in choosing the listener. Keuning et al. (1999), found that experienced transcribers transcribe better than less experienced ones.

1. *Whether and how to train the listeners to optimise listener agreement*

Low reliability in perceptual assessment of cleft palate speech has been found in some studies e.g. Gooch et al. (2001); Sell, (2005), Brunneg°ard and Lohmander, (2007). Sell et al. (2009) reported that one way to increase inter-rater reliability is by training the listeners, which improves inter-rater reliability of perceptual evaluation of disordered speech. Transcriber agreement in many cleft palate speech studies has been reported at about 80-90% based on phonetic transcription (Chapman & Hardin, 1992; Morris & Ozanne, 2003; Willadsen & Albrechtsen, 2006; Chapman *et al.,* 2008; Lohmander & Persson, 2008).

1. *Selection of speech materials and elicitation strategies*

Another reason for the differences in reliability results could be different sampling modes. These include the speech material test design such as sentences and elicitation strategies which are applied for conversational speech. Moreover, methods of calculation and the criteria of agreement might not be comparable in different studies (Shriberg & Lof, 1991; Johnson *et al.,* 2004; Masterson *et al.,* 2005; Henningsson *et al.,* 2008). Different studies on speech impairments, using various types of speech sample, report different results. Small differences have been stated in the studies that compared transcriber agreements in different speech materials in children with speech disorders. Shriberg and Lof (1991) reported that transcription agreements based on continuous speech samples were slightly better than those based on articulation test responses, whereas in a study by Masterson et al. (2005) there were no significant differences in reliability when using a single word task compared with a conversational sample.

Klintö et al. (2011) found that the speech samples did affect reliability measures in cleft speech. They concluded that connected speech in sentence repetition was the best and most valid task for achieving optimal transcription agreement. They also showed the pitfalls of sentence repetition such as appearance of unusual speech production features during the repetition of sentences. They noted that these unusual speech features occur because sentence repetition is a controlled context that is to some extent unnatural, as the sentences might contain unfamiliar vocabulary and they do not allow a child to select or avoid specific words.

1. *Evaluation of nasal resonance and nasal airflow*

Whitehill et al. (2002) suggested that applying direct magnitude estimation could be preferable in research studies because interval scaling might not be a valid method in the evaluation of hypernasality. They nevertheless concluded that interval scaling should remain the approach in a clinical setting because of practical considerations. Riski (2001) stated that reducing the number of choices on a rating-scale may increase the reliability. Current studies use rating-scales with descriptive category judgements (Sell, 2005).

This review has highlighted some of considerations that have been involved in cleft palate speech evaluation. Measuring at the impairment level involves the highly skilled and complex process of data sampling, data collection/recording, archiving, a standardized approach to data analysis (often including phonetic transcription) and interpretation.

Sell et al. (2009) discuss detailed issues relating to standardisation, including the speech sample, data acquisition, recording and listening guidelines. Using a protocol with proven reliability, and a training element with consensus listening, can enhance the validity and reliability of inter-centre comparisons of speech outcomes.

### 3.4.3 Evaluating transcription reliability

The most common way to analyse and calculate transcription agreement is the point-to-point method. It is a calculation of the percentage of the number of agreements divided by the number of consonants that are identified in the speech sample. Many cleft studies use the point-to-point method to assess the transcription reliability e.g. Hardin-Jones & Jones, (2005); Chapman *et al.,* (2008) and Lohmander *et al.,* (2011). There are some limitations in using this method for cleft studies. Cucchiarini (1996) noted three different limitations of the point-to-point method, which are:

1. The agreement between transcription symbols is all-or-none. This means that relationships between speech sounds cannot be taken into account. For example when comparing transcriptions of target /b/ there is more agreement between two transcribers when one transcriber transcribes [b] and another one transcribes [p] in comparison to when one uses symbol [b] and another one uses [x]. The all-or-none method does not capture the varying degrees of discrepancy.
2. The percentage agreement can be affected by chance agreement. When there are multivalued variables, the number of classification categories affects the percentage of agreement. The percentage agreement reduces when the number of categories increases. Therefore, the chance of agreement between two transcribers decreases when they transcribe many speech sounds as different categories.
3. This method does not reflect additional or omitted segments. For example, if one transcriber transcribes [mipӕzeʔ] for Farsi word /mipӕze/ (is cooking) and another transcriber transcribes [mipӕzʔeh], this method cannot account for the additional sound [h, ʔ].

To overcome the above mentioned limitations, Cucchiarini (1996) suggested another approach, named the weighted approach. In this technique different weights are assigned to different types of agreements or disagreements based on the degree of similarity between speech sounds. This technique has been adopted by a number of studies (e.g., Ingram, 2002; Ramsdell *et al*., 2007).

This section reviewed the key literature on the issues that should be noted when using a phonetic transcription and perceptual ratings in research.

## 3.5 Instrumental assessment

Instrumental analysis permits more objective measurement of structural and functional aspects of speech production, whereas perceptual analysis is necessarily subjective. Howard and Heselwood (2011; p.941) stated that ‘’instrumental analyses tell us what kind of events in the physical world give rise to what we hear, and this information is invaluable for our general understanding of the phonetic structure of speech and also for informing clinical intervention and remediation’’. In this section the use of instrumental approaches in analysis of speech production in individuals with a cleft palate will be considered.

### 3.5.1 Acoustic measures

Acoustic analysis techniques measure the movement of vibrational energy through the vocal tract (Moon, 1992). Spectrography and nasometry are classified as acoustic measures. Spectrography comprises a sound analyser together with graphic illustration that shows the acoustic structure of speech sounds. Although spectrography is helpful to show the direct assessment of nasality, most cleft studies use qualitative measures to represent nasality in the cleft palate population (Whitehill & Lee, 2008). The weakest point of spectrographic analysis is that it is difficult to measure the degree of abnormal resonance and airflow in cleft studies. However, there are some studies that tried to use quantitative measures to assess the nasality in speech impairments such as Chen, (1997); Kataoka, *et al.,* (2001), Lee *et al.,* (2005) and Lee *et al.,* (2009).

The Nasometer is a microcomputer-based tool. It measures acoustic energy produced from oral and nasal cavities during speech by using two microphones. One microphone records the acoustic energy from the oral cavity, and the other one records the acoustic energy which is produced through the nasal cavity. Many cleft studies use nasometry to measure the amount of acoustic energy during speech production. The nasal resonance will increase during speech production when the velopharyngeal part is not completely closed. Therefore, the nasometer may indicate hypernasality in the speech of the individual with VPI even if there is no target nasal consonant or nasalized vowel in the speech sample. Some research shows that there is a correlation between perceptual judgement of nasality and nasometer results (Sweeny, 2000, as cited in Sweeny & Sell, 2008). Therefore, the nasometer can be a valuable tool to measure the nasality of cleft population. Kummer (2001) and Peterson-Falzone et al. (2001) described the nasometer and its advantages in detail. However, the nasality score provided by a nasometer might be affected by language, dialect, age, and gender (Seaver *et al.,* 1991; Karnell, 1995). Therefore, comparing the nasality score across languages is difficult. Sell and Grunwell (2001) stated that there are limited normative data for different accents in the United Kingdom. It is important to have reliable and valid norms of nasometry for clinical use. It has been suggested that even when the reliable norms are available, the data provided by nasometry should not be used as a substitution of perceptual judgement in spite of existence of problems related to perceptual assessment (Sweeny, 2011).

### 3.5.2 Aerodynamic measures

These techniques provide the measurement of airflow and air pressure in the oral and nasal cavities. These start from simple devices such as the mirror test, to the combination of airflow meters and pressure transducers. PERCI (the Palatal Efficiency Rated Computed Instantaneously) was designed by Warren (1970). It was subsequently developed to become the PERSI SARS system which uses pressure transducers and flowmeters to record airway pressure within the vocal tract and volume rates of airflow respectively. Sweeney and her colleagues (1999) found that, at the time of production of pressure speech sounds, there is a good correlation between the perceptual judgement of nasal emission and pressure flow measurement.

### 3.5.3 Visual biofeedback

Electropalatography (EPG) is a visual biofeedback technique that is used to investigate articulatory patterns. This technique shows multiple tongue-palate contacts in the approach to and move away from lingual consonant production. It records details of the location and timing of tongue contacts during relatively short utterances (Hardcastle *et al.,* 1989; Hardcastle & Gibbon, 1997). EPG is a useful assessment tool in the diagnosis and treatment of many speech impairments such as: developmental neuromotor difficulties, hearing impairment, stuttering and Down’s syndrome (Carter & Edwards, 2004).

EPG has been broadly used in the study of cleft palate speech in English and other languages such as Japanese. It provides important information in the area of cleft palate speech. Gibbon (2003) mentioned that more than 150 studies about EPG have been conducted in recent years of which half of them focus on children with cleft palate or children whose articulation disorder is functional, and other studies have focused on neurogenic disorders and hearing impairment. Howard (2004) pointed out that a significant amount of studies describe, in detail, several unusual lingual-palatal contact patterns when using EPG, such as broad closure, asymmetrical contact patterns and double articulation, for alveolar and post-alveolar consonant targets. The dynamic production of these targets can be different from the production of these targets in normal speech.

There are three types of EPG pattern which individuals with articulation disorders produce in their speech:

* The pattern whereby tongue–palate contact has an abnormal spatial configuration such as complete tongue–palate contact.
* The pattern that occurs because of abnormal timing, such as long durations.
* The pattern that appears due to abnormal location, such as substitutions (Hardcastle & Gibbon, 1997).

Hardcastle and Gibbon (1997) stated some advantages and limitations of EPG. Being safe is the first important benefit of EPG and furthermore, it is appropriate and easy to use and it can record all the activities of the fast-moving tongue tip because of having a high sampling rate (usually 100-200 Hz). It can reveal covert contrasts made by the child but not perceptible to the listener. In contrast to other techniques, EPG can record the lateral margins of the tongue. Another attractive feature of EPG is its visual feedback. This is important notably in therapy because individuals can see their speech articulation on the computer screen. In spite of these benefits, EPG, as with other instruments, has a number of limitations. In order to apply EPG in assessment and therapy, an artificial palate has to be constructed which is specific for every person who needs to use it. Construction of these plates is time consuming and also expensive. In addition, the plate may interfere with natural speech articulation because of the implementation of an intraoral device. Moreover, it was found that individuals using these plates experienced dissatisfaction and could not adapt to the device being in their mouth. Another limitation of EPG is that it cannot record the tongue movements that are lowered away from the plate, due to minimal or zero EPG contact. Thus, EPG cannot contribute to the identification of certain consonants and vowels that are articulated with minimum contact or without any contact between the tongue and palate, such as bilabial, glottal and pharyngeal consonants, and oral approximants. Another limitation of EPG is that the information that is obtained from EPG cannot singularly determine which part of tongue is involved in the articulation of a specific contact pattern (Hardcastle & Gibbon, 1997).

EPG has some disadvantages for individuals with a cleft palate. Many children with a cleft palate have difficulty in producing high pressure oral consonants (Harding & Grunwell, 1998), and may replace oral targets with post-oral replacements such as pharyngeal or glottal stop (Harding & Grunwell, 1998; Trost, 1981). These types of cleft speech characteristics are not imageable with EPG. Moreover, all individuals with a cleft palate can not use EPG due to requirements for secondary surgery or on-going dental, orthodontic or maxillary input (Roxburgh et al., 2016). Final limitation which is related to children with a cleft palate is that children with irregular shaped hard palate will have a unique shape to their artificial palate and the sensors in the artificial palate may not be placed as evenly and symmetrically as they are shown on the display.

There are some restrictions of use of EPG for research such as expensive computerized equipment. Additionally there would be an age limit because young children may not tolerate the appliance also need to be experienced in using and giving confidence to children and parents.

Other instrumental assessments such as videofluroscopy use techniques that provide clear data relating to the shape, size and range of movement of the palate and the posterior and lateral walls of the pharynx (Mercer & Pigott, 2001). Videofluoroscopy is a noninvasive radiologic technique intended to assess the competency of velopharyngeal closure. It can be recorded onto DVD. It produces a continuous record of the velopharyngeal mechanism and is an instrumental assessment of different forms of velopharyngeal insufficiency including cleft palate. Using videofluroscopy is important in clinical practice when it is time to make a decision about the type of surgical intervention or prosthetic device that is necessary to close the gap in the velopharyngeal portal. In addition, it helps to predict the outcome of a specific type of therapy for an individual with a cleft palate (Skolnick & Cohn, 1989).

Another instrumental assessment is ultrasound tongue imaging (UTI). UTI is a technique which is similar to EPG but it does not require individualized hardware which is expensive or stability of dentition. Ultrasound tongue imaging makes images from near the tongue tip to the root. Pharyngeal articulations are also apparent. UTI can be an alternative choice of EPG for individuals with a cleft palate (Roxburgh *et al.,* 2015). It provides information on tongue shapes easily in comparison with other imaging techniques. Recently, it has been used to examine compensatory articulations in cleft palate speech with quantitative measures suggested to analyse UTI data of compensatory articulations (Zharkova, 2013). However UTI has been used as a visual biofeedback since around 1980 (Shawker & Sonies, 1985), it does not provide a context for lingual tongue movement.

Using ultrasound-based measures of tongue function as well as other established techniques in speech therapy will be helpful to achieve accurate diagnose which would allow more effective treatments to be selected.

In summary, various instrumental tools have been invented that focus on improving a clinical judgement of articulation disorders and velopharyngeal impairment. However, none of these instrumental measures would be sufficient for speech assessment in isolation. They are supplementary to the perceptual assessment but may be selected to provide specific additional information. Instrumental assessments are valuable to investigate abnormalities in structure or function of the speech organism. A speech and language therapist who has trained in this field plays an important role in investigating and interpreting the provided data. Sell et al. (2009) stated that this clear evidence helps the multidisciplinary team to make an appropriate decision on whether the patient needs surgery and/or speech and language intervention.

## 3.6 Summary

This chapter has reviewed different issues associated with speech assessment in individuals with a cleft palate. The first part of this chapter was about types of perceptual analysis, including rating scales and phonetic transcription. The advantages and disadvantages of perceptual analysis were also discussed. Despite its limitations, perceptual analysis is the most important and useful approach to use as a clinical and research tool. Besides, instrumental analysis provides valuable information about the physical objects of speech production. Combination of perceptual and instrumental analyses would result in the optimal data set for speech analysis.

Chapter 2 and 3 discussed different issues in relation to speech development and specific speech features in the individuals with a cleft palate. In addition, different assessment methods that are employed to assess these specific speech characteristics have been explained in these chapters. As the description of cleft speech characteristics in Farsi is a particular goal of this research, developing a Farsi assessment for cleft palate speech are essential. This will be discussed in the next chapter.

# Chapter 4 Developing a Farsi assessment for cleft palate speech

## 4.1 Introduction

For a speech assessment tool to be of value in facilitating the identification and management of particular communication difficulties, for example those relating to cleft palate, the tool must be tailored to the needs of the specific language with which it is intended to be used.

This chapter describes the Farsi assessment protocol and the speech assessment material which have been developed for the current study based on GOS.SP.ASS’98 (Sell *et al.,* 1999). This will be followed by a description of the preliminary modifications made to GOS.SP.ASS’98 to provide an appropriate perceptual cleft speech assessment tool for Farsi-speaking individuals with a cleft palate.

## 4.2 Speech assessment protocol for Farsi

In recent years a primary objective in cleft lip and palate speech research has always been to develop framework for measuring speech which is reliable and facilitates inter-centre and cross linguistic comparisons (John *et al.,* 2006). McComb (1989) suggested that a standardised speech assessment should be developed, at least on a national, and ideally an international, basis for making inter-centre comparisons. Designing a linguistically and culturally relevant Farsi speech assessment protocol is important for the identification and management of speech problems related to cleft palate in Iran. There are some modifiable factors which should be considered in adaptations of speech assessment protocol for individuals with a cleft palate, including language, speech parameters and measurement methods. As was mentioned before, there is no standard and reliable speech assessment protocol for Farsi-speaking individuals with a cleft palate. Thus, one of the principal aims of this research is to develop a linguistically and culturally appropriate speech assessment tool that can be used in clinical and research contexts.

After a comparison of various systems that are used for the assessment of speech in individuals with a cleft palate, GOS.SP.ASS’98 was chosen as the main foundation for the development of the assessment procedure in this study. The reasons for this decision are as follows:

1. According to a U.K survey (Razzell and Harding, 1995, cited in John et al, 2006), GOS.SP.ASS’94 (Sell *et al.,* 1994) was identified by a group of ten clinical lead SLTs as the preferred cleft speech assessment protocol in comparison with five other protocols, which were reviewed for both research and clinical purposes. The scale parameters for this survey were ease of use, speed of use, breadth of information and accessibility of information from completed forms. Following feedback from the comparative study GOS.SP.ASS’94 was revised in 1998 (GOS.SP.ASS’98; Sell *et al.,* 1999). Sell and colleagues (1999) made some modifications to GOS.SP.ASS’94 in order to eliminate ambiguities. Furthermore, they added some parameters and scales, which are beneficial in clinical management. Therefore, GOS.SP.ASS’98 has been trialled, amended, and has now been used across all UK centres for assessing cleft palate speech for over 15 years. It was tested and validated in the Turner Memorial study which was reported but not published (Harding & Grunwell, 1996) and, subsequently, it was the basis of the CAPS-A audit assessment tool which has been proven to be valid and reliable for audit purposes (John *et al.,* 2006). Expert clinicians report a number of benefits from using the GOS.SP.ASS. The nature of the speech sample includes a core of replicable data but also has the flexibility to include spontaneous speech, rote speech, and to take parent report into consideration. The use of narrow transcription and the categorisation of features observed in speech data facilitate data analysis at phonetic, phonological and psycholinguistic perspectives (Howard & Harding-Bell, 2011). The list of ten cleft speech characteristics is evidence-based. The use of a recognised structured assessment ensures that all speech assessments are comprehensive. The formal structured format facilitates development of clinical expertise, accurate clinical management, and consistently replicable and comparable assessments. The GOS.SP.ASS format has been used for a wide range of inter-centre international and cross-linguistic studies. This is a comprehensive speech assessment protocol that is appropriate for speech disorders associated with cleft palate and/or velopharyngeal dysfunction (Sell *et al.,* 1999). It is also considered to be appropriate for both research and clinical domains and can be used to measure reliability (Sell *et al.,* 1999; John *et al*., 2006). It has also been translated into other languages and adopted into clinical practice (Mekonnen, 2013; Al-awaji, 2014).
2. The speech sample includes sentence repetition. Each sentence used in GOS.SP.ASS’98 includes familiar words containing a specific target consonant in a range of word positions in a phonetically controlled context. These sentences can be replicated in other languages. German (Bressmann et al., 2002), Amharic (Mekonnen, 2013) and Arabic (Al-awaji, 2014). Translation into Farsi was expected to be equally possible.
3. The GOS.SP.ASS’98 protocol is not just a tool for assessing speech production including articulation, nasal resonance and voice. It also includes observations of visual appearance of speech, a systematic approach to an oral examination, the collection of relevant hearing and medical history and of relevant information from the parents. Therefore GOS.SP.ASS helps the examiners to identify the aetiological factors and plan for further management. Whilst this additional information would not be included in the present study, if adapted for use in Iran it would be relevant and necessary for accurate differential diagnosis.

In summary, the GOS.SP.ASS assessment provides a well-founded framework upon which to assess cleft speech in Farsi-speaking children. In particular, the GOS.SP.ASS protocol, which elicits speech in a sentence repetition task and transcribes consonant production in a range of word and syllable positions, would facilitate detailed comparison of cleft speech characteristics between English and Farsi. Analysis of consonant production was a primary interest in this research. It is anticipated that the use of the modified Farsi version of GOS.SP.ASS’98 for data collection in this project will inform evaluation of its potential for clinical purposes in the future.

## 4.3 The design of the modified GOS.SP.ASS for Farsi

This section presents a description of the design of the Farsi GOS.SP.ASS (Appendix 3), which is a modified version of the English GOS.SP.ASS’98 (Sell *et al.,* 1999). There are only a few modifications in consonant realisations (linguiolabial articulation and interdental articulation), which were made because of differences in the structure of Farsi and English. The Farsi version of GOS.SP.ASS, similar to the original, consists of main sections including patient information, resonance, nasal airflow, consonant realisations, developmental errors, a summary of speech patterns, child’s history of speech and language therapy, voice, the visual appearance of speech, oral examinations, language, identification aetiology, areas requiring further assessment, a management plan and finally additional notes. Each section will be described below.

### 4.3.1 Patient identification information

This part of the assessment framework includes name, date of birth, date of interview, hospital number and tape number which are essential information. Morris and Shelton (1990) highlighted that additional information about type of cleft palate and time of surgery is valuable if this protocol is also to be used to assess surgical outcomes. Moreover, Henningsson (2008) proposed to add the name and address of the parents or contact person as well as the gender of the patient. Therefore, the Farsi GOS.SP.ASS includes all this information.

### 4.3.2 Rating nasal resonance and nasal airflow

The speech parameters that are described in this section are hypernasality, hyponasality, mixed resonance, nasal emission, nasal turbulence and grimace.

### 4.3.2.1 Hypernasality

As was mentioned previously, different rating scales have been applied for hypernasality assessment in different protocols. The Farsi GOS.SP.ASS, similar to the original GOS.SP.ASS, uses a four point-scale for various degrees of hypernasality. Each point shows the level of severity of hypernasality. Grade 0 is used when no hypernasal resonance is perceived. Grade 1 shows hypernasality perception in the production of approximants and vowels. Grade 2 is applied when hypernasality is perceived on vowels, approximants and also where there are significantly weakened consonants with nasalisation of voiced consonants. Grade 3 indicates the perception of hypernasal resonance on all the above characteristics and when /b, d, ɡ/ are replaced by their nasal equivalents [m, n, ŋ]. Razzell (1996) stated that listener agreement is very variable for the perception of hypernasality whereas Sandy et al. (2001) showed a very high level of inter-rater reliability with this type of four-point scale. A four point-scale is therefore recommended by many authors, such as Henningsson et al. (2008) and Sweeney (2011).

Another feature which is considered for hypernasality in GOS.SP.ASS’98 is consistency. As hypernasality can be consistent or inconsistent, GOS.SP.ASS’98 provides options to record this. Therefore, the-four point rating scales of hypernasality and consistency are incorporated into the Farsi GOS.SP.ASS protocol from the original GOS.SP.ASS’98 protocol.

### 4.3.2.2 Hyponasality

Hyponasal resonance is judged on the perception of target nasal consonants such as /n, m, ŋ/. It is rated on a three point-scale in GOS.SP.ASS’98 compared to a binary system in other protocols such as GOS.SP.ASS’94 (Sell et al, 1994) and Universal Parameters (Henningsson *et al.,* 2008). Following GOS.SP.ASS’98, a three point-scale is used in the Farsi GOS.SP.ASS because this type of rating indicates the severity of the hypernasality resonance. Hyponasal resonance should be rated in the speech of individuals with a cleft palate because both hypernasality and hyponasality might be observable in the same speech sample. Grade 0 shows no hyponasality is perceived. Grade 1 indicates moderate hyponasal resonance in nasal consonants. Therefore nasal consonants are perceived to be moderately denasal. Grade 2 is applied when the target nasal consonants are perceived as oral plosives. In the Farsi GOS.SP.ASS similar to GOS.SP.ASS’98, consistency in hyponasality is evaluated, using two categories ‘Consistent’ and ‘Inconsistent’. ‘Cul-de-sac’ and ‘mixed resonance’ are also included in the resonance assessment, and similar to GOS.SP.ASS’98 a binary classification (absent or present) is used.

### 4.3.2.3 Nasal emission

Nasal emission is when an improper escape of air takes place through the nasal cavity. It is most perceptible on the production of voiceless oral pressure consonants such as plosives, fricatives and affricates. Sweeney (2011) states that the presence of nasal emission might be due to incomplete closure of a velopharyngeal sphincter and/or an existence of fistula in the palate. Nasal emission can be audible or inaudible. Sell et al. (1999) proposed that nasal emission is audible or inaudible in various degrees in the speech sample. The two categories used in the Farsi GOS.SP.ASS are the same as in the GOS.SP.ASS’98: audible or inaudible nasal emission. Inaudible nasal emission, which is not perceived by a listener, is detected by a mirror test. In the mirror test, which is included in both the Farsi GOS.SP.ASS and the original GOS.SP.ASS’98, a mirror is held under the nose to see whether there is misting on the mirror during the production of sequences consonant-vowel syllables such as [pa pa pa] and [pi pi pi]. Nasal emission is rated on a three point-scale in the original GOS.SP.ASS’98. Grade 0 is applied when there is no nasal emission in the speech. Grade 1 is for when there is inaudible or gently audible emission through the nasal cavity and Grade 2 is used for perception of significant nasal emission. The Farsi GOS.SP.ASS uses the same type of rating for nasal emission. Further categories used in the original GOS.SP.ASS relate to whether the nasal emission is consistent or inconsistent, and whether it is accompanying or replacing consonants. The Farsi GOS.SP.ASS also applies these categories.

### 4.3.2.4 Nasal turbulence

Nasal turbulence is described as a more severe type of audible nasal emission (Sell *et al.,* 1994). Kummer et al. (1992) stated that nasal emission is related to a large velopharyngeal opening, whereas nasal turbulence is associated with a small velopharyngeal opening. Therefore, nasal turbulence is perceived as more severe than nasal emission although the underlying structural problem is less severe. It has also been described as ‘snorting’ (Duckworth *et al.,* 1990) or a ‘nasal rustle’ (Kummer *et al.,* 1992). It is perceptible in speech possibly due to the insufficient closure of the superior edge of the velum and the posterior pharyngeal wall (Duckworth *et al.,* 1990). Nasal turbulence, similar to nasal emission, is rated on a three point-scale in GOS.SP.ASS’98. The Farsi GOS.SP.ASS also uses this three point-scale. Grade 0 shows that there is no nasal turbulence in the speech. Grade 1 is used when slight nasal turbulence is observed and finally grade 2 is used when severe and disturbing nasal turbulence is perceived. As in the nasal emission criteria, there are additional categories within the consistency of nasal turbulence to identify whether it replaces or accompanies the consonant.

### 4.3.2.5 Grimace

A nasal or facial grimace is a frequent and visible behaviour which is related to nasal emission. Many individuals with a cleft palate constrict the nasal flares to prevent abnormal nasal airflow. In more severe forms they exhibit grimaces in other facial muscles including upper lips and forehead (Sell *et al.,* 1994; Sweeney *et al.,* 1996). Although a grimace is not an audible speech behaviour, it should be considered as one of the aspects of cleft palate speech assessment, because it indicates the probability of velopharyngeal insufficiency and in addition it may indirectly affect the communication process. The listener might be distracted from the speech message by seeing the grimace (Sell *et al.,* 1994). Grimace is rated on a four point-scale in GOS.SP.ASS’98. Therefore, the Farsi GOS.SP.ASS, following the original GOS.SP.ASS’98, uses a four point-scale. Grade 0 indicates no grimace produced by the speaker with a cleft palate. Grade 1 indicates presence of nasal flare. Grade 2 is used when the grimace includes nostrils and upper lip and finally grade 3 indicates the most severe form of grimace involving the mid and upper face.

### 4.3.3 Consonant production

The consonant production chart shows the realisations of consonants in different word positions: syllable initial word initial (SIWI), syllable initial within word (SIWW) and syllable final word final (SFWF). The consonant targets in the GOS.SP.ASS’98 were chosen based on the reported occurrence of place of articulation errors made by speakers with cleft palate (Harding & Grunwell, 1993; Harding *et al.,* 1997). The Farsi GOS.SP.ASS also uses this criterion. The chart helps to rapidly identify the place of articulation error patterns (Sell *et al.,* 1999). Whereas the UK GOS.SP.ASS only includes SIWI and SFWF, syllable initial within word (SIWW) has been added to the Farsi version of GOS.SP.ASS. These three separate positions are included on the chart to capture potential articulation variability across different word positions within the sentence repetition task. Some children might produce a sound correctly at syllable initial word initial position but may have difficulties at syllable initial within word position, so in order to see variations caused by elicitation type this study included syllable initial within word position. Other studies, e.g. Mekonnen (2013) and Al-awaji (2014), have followed a similar approach.

### 4.3.3.1 Cleft speech characteristics in the Farsi GOS.SP.ASS

In the GOS.SP.ASS (Sell *et al.,* 1994) the classification of some cleft speech characteristics was unclear. For example, palatal, pharyngeal, glottal articulations were included in one sub-category. Following the feedback from the Turner Memorial comparative study (Razzell *et al.,* 1996; Harding *et al.,* 1997) the cleft speech characteristics section was revised and re-categorised in relation to place of articulation. GOS.SP.ASS’98 categorises error-types based on place of articulation, ordered by articulation in the anterior or posterior of the oral cavity or the non-oral cavity.

Patterns of change can be monitored more easily in the revised GOS.SP.ASS’98 protocol (Sell *et al.,* 1999). The Farsi GOS.SP.ASS follows the structure and categorisation system of the UK GOS.SP.ASS. The cleft speech characteristics (CSCs) are divided into four categories: anterior oral cleft speech characteristics, posterior oral cleft speech characteristics, non-oral cleft speech characteristics and passive cleft speech characteristics*.* All of the following descriptions and definitions are derived from GOS.SP.ASS. The study to be carried out aims to establish whether these characteristics occur in Farsi cleft speech data and whether there are other phenomena that occur in Farsi but not in English.

It should be noted that two cleft related features are added to the anterior oral cleft speech characteristics in the Farsi version of GOS.SP.ASS: linguolabial articulation and interdental articulation. Linguolabial articulation might not have been of interest in the English-speaking world but two recent studies in Amharic (Mekonnen, 2013) and Arabic (Al-awaji, 2014) showed that linguolabial articulation is a cleft related characteristic. Furthermore, an unpublished study in Farsi (Derakhshandeh *et al.,* 2013) found this feature as a related cleft characteristic. Therefore, it was predicted that linguolabial articulation would be found in the Farsi-speaking children with a cleft palate tested for the present study. Thus this subcategory is added to the Farsi version of GOS.SP.ASS.

Another feature which might be observed in the speech of Farsi-speaking children with a cleft palate is interdental articulation, firstly because, there is no interdental consonant in the Farsi consonants inventory, and secondly because a subsequent publication of CAPS-A (Sell, 2009) included interdental articulation in the oral cleft speech characteristics category. Moreover, this feature was found in the speech of Amharic-speaking children with a cleft palate (Mekonnen, 2013).

### 4.3.3.1.1 Anterior oral cleft speech characteristics

This category refers to articulation of an anterior consonant for a target consonant within the oral cavity as a cleft speech feature. The category of anterior oral cleft speech characteristics consists of both primary and secondary articulations. In primary articulation the place and/or manner of articulation of the target consonant are changed whereas in secondary articulation there is no change in the primary place or manner of articulation of the target consonant but it is accompanied by the secondary articulation. Primary articulations include *linguolabial, interdental, lateral,* and *palatal articulations* while secondary articulations include *interdentalisation, dentalisation, lateralisation/lateral* and *palatalisation/palatal.*

### 4.3.3.1.1.1 Linguolabial articulation

Linguolabial articulation occurs when the tongue tip or blade contacts the upper lip (Ladefoged & Maddieson, 1996) for example, [t̼]. Although cross-linguistically this type of articulation is rare in the speech of typically-developing children, it is frequently observed in the speech of individuals with a cleft palate, probably due to class III malocclusion of teeth associated with poor maxillary growth (Sell *et al.,* 1994).

### 4.3.3.1.1.2 Interdental articulation and Interdentalisation

Interdental articulation occurs when the tongue is placed between upper and lower front teeth (Ladefoged & Maddieson, 1996). Similar to linguolabial articulation, it might be because of malocclusion of teeth. In this situation the size of the maxilla is small. Therefore, the tongue does not have very much room to manoeuvre and tends to be further forward (Sell *et al.,* 1994). As a result alveolar consonants are produced as atypical interdental or linguolabial consonants. Interdental articulation can be a normal developmental immaturity in the speech of children who speak English. Thus this characteristic would only be noted on form if speaker is older than 4 years old. In contract interdental articulation is not a normal developmental immaturity in the speech of Farsi-speaking children.

### 4.3.3.1.1.3 Dentalisation

Dentalisation occurs when the speech target which is not dental is articulated with the tip of the tongue touching the front teeth (Ladefoged & Maddieson, 1996). As in GOS.SP.ASS’98, it is included in the Farsi GOS.SP.ASS due to the occurrence of this atypical type of articulation in the speech of older children with a cleft palate.

### 4.3.3.1.1.4 Lateral articulation and lateralisation

Lateral articulation is an articulation in which the airflow is directed around the sides of the tongue while the tongue closes the centre route (Ladefoged & Maddieson, 1996). Target consonants might be realised with a secondary lateral articulation such as /s/ → [sˡ] (lateralisation) or might be articulated as lateral fricatives such as /s/ → [ɬ].

### 4.3.3.1.1.5 Palatal articulation and palatalisation

Sell et al. (1999) highlight the distinction between palatal articulation and palatalisation. Palatal articulation is a primary articulation toward or in contact with hard palate, whereas palatalisation is a secondary articulation that modifies a primary articulation located in front of the hard palate, when the body of the tongue is raised towards the hard palate without causing friction or making complete closure. Similar to the GOS.SP.ASS’98, this category is used in the Farsi GOS.SP.ASS.

### 4.3.3.1.1.6 Double articulation

This refers to speech sounds which have two simultaneous articulations of the same degree of stricture (Ladefoged & Maddieson, 1996). This category is placed in the anterior and posterior oral cleft speech characteristics in the GOS.SP.ASS’98 because when double articulation is realised for alveolar plosive target consonants, such as /t/→[t͡k] or /d/→[d͡ɡ], it is difficult to identify whether it is perceived as an alveolar (anterior oral CSCs) or as a backing error (posterior oral CSCs) (Sell *et al.,* 1999).

### 4.3.3.1.2 Posterior oral cleft speech characteristics

This section includes *backing to velar* and *backing to uvular*

### 4.3.3.1.2.1 Backing to velar

This category shows when a child realises alveolar targets such as /t, d, s/ as velar sounds such as [k, ɡ, x]. As in GOS.SP.ASS’98, this category is included in the Farsi GOS.SP.ASS.

### 4.3.3.1.2.2 Backing to uvular

This category indicates the occurrence of uvular sounds such as [q, X] for velar targets such as /k, ɡ/.

### 4.3.3.1.3 Non-oral cleft speech characteristics

These include cleft speech characteristics which are articulated outside the oral cavity; *pharyngeal articulation, glottal articulation* and *nasal fricative articulation*.

### 4.3.3.1.3.1 Pharyngeal articulation

This category indicates when one of the compensatory articulations occurs below the level of the velopharyngeal valve (Sell *et al,* 1994). The only pharyngeal articulations symbolised in the IPA are the pharyngeal fricatives [ħ, ʕ], and these are also the only ones included in GOS.SP.ASS’98.

### 4.3.3.1.3.2 Glottal articulation

This category refers to instances where consonant targets which are typically realised within the oral cavity are replaced by post-uvular consonants such as glottal stop [Ɂ] and glottal fricative [h]. Double articulation of oral stop and glottal stop such as [tɁ], [dɁ] are placed in this category in the GOS.SP.ASS’98, whereas this type of articulation is located in a separate double articulation category in the Farsi GOS.SP.ASS. As mentioned before, it is difficult to identify the precise place of a double articulation whether it is perceived as an oral stop or a glottal stop. Therefore, all the targets which are realised with double articulation are located in the double articulation category.

**4.3.3.1.3.3 Active nasal fricative**

This category includes fricative targets realised by voiceless nasals with additional audible nasal emission (Sell *et al.,* 1999), for example, realisation of /f/ as [m̥͋] or /s/ as [n̥͋]. This realisation occurs when the speaker stops oral airflow and actively redirects the airflow nasally (Harding & Grunwell, 1996; Harding-Bell & Howard, 2011). Therefore, it is directed completely nasally (Sell *et al.,* 1999). It is not always possible to determine whether the nasal airflow is active or passive without occluding the nares. It is important to note that perceptually distinguishing between passive nasal realisation of fricatives and active nasal fricatives is difficult. However the manner in which they are articulated helps to distinguish them (Sell *et al.,* 1999). Harding and Grunwell (1998) pointed out that the distinction between active and passive nasal fricative realisation can be made by nose holding. Nose holding inhibits nasal consonant production and it will inhibit production of an active nasal fricative. The identification of realisations which are consequences of using active compensatory strategies are important because active nasal fricative articulations often persist after surgical interventions (Sell *et al.,* 1999). Moreover, if a backing pattern is observed in the speech of individuals with a cleft palate, target nasal fricative realisations for /s, ʃ/ are frequently backed to velar nasal fricatives [ŋ̥͋] (Sell *et al.,* 1999).

### 4.3.3.1.4 Passive cleft speech characteristics

This category includes the features that occur with no active compensatory strategies. These characteristics are considered to be passive because of structural anomalies or dysfunctions which are effects of a cleft palate. Harding-Bell (2010) stated that these CSCs are identified when children with a cleft palate match the place of articulation of the target but they are unable to achieve normal intra-oral pressure. Passive cleft speech characteristics are categorised into weak/nasalized articulation, nasal realisation of fricative, nasal realisation of plosive, absent pressure consonants and gliding of fricatives/affricates.

### 4.3.3.1.4.1 Weak and/or nasalised articulation

Henningson et al. (2008) pointed out that a weak and/or nasalized realisation occurs when perceptually the target maintains its identity but loses some or most aspects of its oral quality. They also mentioned that this is likely to be associated with moderate or severe hypernasality. Similarly Sell et al. (1999) stated that weak oral pressure consonants might be associated with nasalized consonant articulation, e.g. [d͉̃, z͉̃]. Additionally, this type of realisation might be observed due to velopharyngeal insufficiency (Hutters & Bronsted, 1987; Harding & Grunwell 1998a).

### 4.3.3.1.4.2 Nasal realisation of fricatives (passive nasal fricative)

Nasal realisation of fricatives involves passive escape of air nasally (Sell *et al.,* 1999). This type of realisation occurs when fricative consonants such as /f, v, s/ are perceived as voiceless nasals but the speaker has intended an oral articulation. They have made the correct articulatory gesture for the target phoneme but the predominant airflow is perceived by the listeners as nasal.

During production of an alveolar passive nasal fricative, the tongue posture is as for a grooved lingual fricative, but the airstream is perceived as nasal; this nasal airstream is reduced or disappears with nose holding, resulting in an audible oral fricative (Sell *et al.,* 1999).

### 4.3.3.1.4.3 Nasal realisation of plosives

This is a classic type of cleft speech characteristic (Sell *et al.,* 1999). It refers to the substitution of nasal consonants such as [m, n] for a plosive target such as /b, d/ (Hutters & Brondsted, 1987; Harding & Grunwell, 1998). This type of realisation frequently occurs because of the lack of intra-oral pressure (Sell *et al.,* 1999).

### 4.3.3.1.4.4 Absent pressure consonants

This category refers to speech patterns containing no consonants requiring intra-oral pressure, and pressure consonants are completely absent. A child with no pressure consonants will have a very limited range of consonants. Nasal and approximant consonants [m, n, ŋ, w, l, j] and [ʔ] with a likely glottal fricative [h] are included in this narrow range (Sell *et al.,* 1999). It has been noted that this type of speech characteristic could indicate a velopharyngeal insufficiency (Sell & Ma, 1996).

### 4.3.3.1.4.5 Gliding of fricatives/affricates

This category includes the fricative or affricate targets, such as /s, ʃ, ʧ/, perceived as glides, such as [j, w], (Sell *et al.,* 1999). This feature has been observed in the speech of non-cleft children as well. Grunwell (1987) pointed out that this type of gliding is an unusual developmental process in the speech of non-cleft children. Although it is a common realisation in cleft palate speech, it is not known whether it is associated with a compensatory strategy or with passive strategies that are related to VPI. It can be one of the atypical developmental processes that persist due to a cleft palate (Sell *et al.,* 1999). As the substitution of glide [j] for fricative targets /s, z, ʃ/ was observed consistently in their data (1998), Harding and Grunwell (1998) considered this characteristic as a process which takes place in the speech of children with a cleft palate.

### 4.3.3.2 Developmental realisations

All the speech sounds that are frequently realised in the speech of non-cleft children as developmental errors are included in this category. These developmental errors might indicate a coexisting phonological disorder or might mask articulatory constraints due to a cleft palate as well (Sell *et al.,* 1999). They might include normal developmental immaturities as specified by Henningsson et al. (2008). Atypical developmental errors that are not thought to be associated with deficiencies in the speech mechanism are also included under the heading developmental errors. Based on Henningsson et al. (2008), developmental realisations involve fronting, cluster reduction, stopping, gliding of liquids and consonant omission.

### 4.3.3.3 Summary of speech patterns

This section of the Farsi GOS.SP.ASS shows an overview of the findings from the speech analysis of the child with a cleft palate. After the individual CSCs have been identified it is possible to classify each CSC according to the broad categories of anterior CSCs, posterior CSCs, non-oral CSCs, passive CSCs, and developmental errors respectively. A rating 6 is used if other speech patterns that are not described as cleft speech characteristics are realised in the speech outcome of child with a cleft palate.

### 4.3.4 Speech and language therapy

This section allows the assessor to note the current situation of children’s speech and language therapy intervention by selecting from the following categories: *unnecessary, waiting list, therapy ongoing, regular review, unavailable* and *no uptake.*

### 4.3.5 Relevant information from parents

This section is for recording the information obtained from the child’s parents that is related to intensity, frequency and focus of therapy, the child’s health, hearing, progress at school and any family concerns with speech and appearance.

### 4.3.6 Voice

This descriptive category, which is used in GOS.SP.ASS’98, includes normal, dysphonic and reduced volume sections. John et al. (2006) used a binary system (absent vs present) for voice evaluation in their study. They stated that using a binary system increases the intra-rater reliability. Henningsson et al. (2008) also used a binary system for the evaluation of voice (0 for no voice disorder and 1 for voice disorder). Similar to John et al. (2006) and Henningsson et al. (2008), the Farsi version of GOS.SP.ASS uses a binary system.

### 4.3.7 Visual appearance of speech

This category identifies any significant appearance of speech which is visual, such as tongue protrusion, shortened upper lip and asymmetrical facial appearance.

### 4.3.8 Oral examination

This section includes structural anomalies or dysfunctions in the nose, lips, occlusion, dentition, the tongue, hard palate, soft palate and nasopharynx which are the effects of a cleft palate.

### 4.3.9 Language

This category consists of three sections: normal, delayed and disordered. These three sections are to record the information about expressive and receptive language from normal to disordered. A ‘language delay’ is used when there is a delay in acquisition of language skills in comparison with the child’s peers. In this situation the child follows the usual patterns and sequences but slower than his/her peers. A ‘Language disorder’ is defined by the American speech language hearing association (ASHA) as ‘’ *a significant impairment in the acquisition and use of language across modalities (e.g., speech, sign language, or both) due to deficits in comprehension and/or production across any of the five language domains (i.e., phonology, morphology, syntax, semantics, pragmatics)*’’.

### 4.3.10 Etiology

This is an additional category for recording possible etiological factors that might be associated with a cleft palate such as many syndromes - e.g. velocardiofacial syndrome arising from 22q11 microdeletion (Shprintzen *et al.,* 1978, 2008) - which causes VPI and cardiac problems. Additional information from other members of the multidisciplinary team is recorded here as well.

### 4.3.11 Areas requiring further assessment

The matters which require extra consideration are noted here. These can include other team members’ opinions, valuable phonetic transcriptions, and information received from instrumental assessments such as videoflouroscopy and nasometry.

### 4.3.12 Management plan

This section is to record the intervention plans and recommendations for further management.

### 4.3.13 Additional notes

Further comments and notes can be recorded in this section. They can be notes about parental attitudes or recommendations from the speech and language therapist.

## 4.4 Development of speech materials for the Farsi version of GOS.SP.ASS’98

One of the most challenging aspects of the development of the Farsi version of GOS.SP.ASS’98 was creating a set of sentences and choosing single words as speech elicitation material. The following procedures were carried out to obtain the adequate speech samples for the Farsi GOS.SP.ASS protocol. As the GOS.SP.AS’98 made no rating of intelligibility (Sell et al, 1999; Sell, 2005), spontaneous speech was not used in this particular study as a speech sample.

### 4.4.1 Speech samples

It is important for the speech sample to provide the necessary data that will enable precise analysis as the basis for a definitive diagnosis. Moreover, a speech elicitation task needs to be developmentally appropriate. Sell et al. (1999) suggested that the sample should include:

1. Suitable speech sounds, which means that the materials should be designed to be particularly sensitive to cleft palate speech errors;

2. A sufficient length of speech sample

3. Appropriate syntax for the child’s developmental level.

To accomplish these criteria in this study, it was important to sample speech in varied contexts. As mentioned previously, the speech samples in this research are based on the GOS.SP.ASS’98 protocol. GOS.SP.ASS uses a set of sentences for speech sample elicitation. Therefore, the main speech sample in Farsi GOS.SP.ASS is sentence repetition. Single word naming was added to the Farsi GOS.SP.ASS-based speech sample only as a back-up. Single word naming is not an elicitation material in UK GOS.SP.ASS. In a clinical context it might not be routine to collect single words as well as sentences. For this study it was decided to include the additional single word data for all children. Most single words were used in the sentences because when there was an ambiguous word in the phrase, single word could help to clear it.

As the particular focus for comparison was on consonants production, other elicitation materials in GOS.SP.ASS’98 such as connected speech, counting and a nursery rhyme which are used for rating resonance, and voice were not included. Thus, the contents of the speech sample were the repetition of 23 sentences and a production of 68 single words. The word list and sentences are based on the results of investigating the sound system of Farsi, described earlier in this chapter.

### 4.4.1.1 Sentences

As mentioned above, in order to have comparable data samples across languages, it was decided to use the established GOS.SP.ASS procedure of sentence repetition, using sentences constructed to elicit specific consonant sounds. Klinto et al. (2011) found that sentence repetition to be most established method of obtaining a speech sample in order to establish whether specific targets can be achieved and thereby provide information about a child’s phonetic repertoire. There is the advantage of controlling the context of the child’s speech production and thus enabling the analysis to associate the child’s production with known target words and sounds. Therefore, 23 sentences were devised with each targeting a single consonant in three different positions. .

Consonant which in the literature treats /ɣ/ as the phoneme (table 4.2) is not in the sentence list because in the Tehrani accent which is the accent that participants learned to speak, /ɣ/ is used as it’s allophone [G]. Thus it is decided to use this allophone in the sentence elicitation in this research.

These sentences have been constructed based on the following guiding principles. It should be noted that an attempt was made to pursue the guiding principles but some restrictions remained because of the phonotactic features of Farsi.

An attempt was made to follow the guidelines but due to the phonotactic features of Arabic, the problem could not always be avoided.

1. The target consonant is selected according to place of articulation, as in the (English) GOS.SP.ASS sentences.

2. Sentences should be meaningful and imageable.

3. Sampling the target consonant in the initial, medial and final position of the word in each sentence.

4. In each sentence, minimizing the occurrence of vulnerable consonants whose pronunciation might interfere with the production or perception of the target sound. In particular fricative sounds were used less, because they might affect perception of other consonants. The use of nasal consonants in the sentences was minimised as nasal consonants are likely to increase nasality across adjacent segments.

5. Word-final targets were followed by word-initial vowels at every opportunity so that the final consonants were neither assimilated to the first consonant in the following word, nor left unreleased being the last consonant in the sentence.

6. Limiting the numbers of syllables in each sentence, to between 4 and 8 syllables.

7. Preference for using phrases. As Farsi is a syntactically complex language and the creation of short sentences was not feasible for some target consonants, phrases were preferred rather than full sentences.

8. Using some of the words from the single word elicitation in the sentence repetition. At the analysis stage, this allowed for direct comparison of pronunciation of the target consonant in single word vs. connected speech contexts.

9. Including all 23 Farsi consonants in these 23 sentences.

### 4.4.1.2 Pilot study

A pilot study was conducted specifically to determine whether the designed Farsi sentences would be efficacious. The sentences and single word elicitation materials were presented to one typically-developing child aged 6;1. As the child lived in the U.K., he had been exposed to both English and Farsi and was bilingual. This pilot study was arranged through a personal contact at the University of Sheffield and the aim of the study was described to his parents. The child was assessed individually in a quiet room and the whole session took about 45 minutes. The session was recorded using a high quality video and audio recorder. The test included a list of 23 sentences that the child was asked to repeat. If the child could not repeat the sentence, or repeated only part of the sentence, the target sentence was repeated more slowly and if the child still did not respond, the examiner moved to the next sentence.

This testing revealed that some of the sentences were difficult for the child to produce. He failed in his production by stopping part way through or by using the wrong words. The reason might be that some of the sentences were too long or linguistically complex. For example, he could not repeat this ten syllable sentence /ʧɒdor ru dære komod oftɒde/ ‘ The scarf is on the wardrobe’s door’. Following analysis of the speech data, according to the speech realisations of this child, revisions to these materials were carried out.

### 4.4.1.3 Some issues in constructing the sentence sample

The feasibility of the sentence repetition task was addressed in the pilot. Hence, the study primarily examined whether the designed sentences are short, simple and imageable enough for the target children to produce them. The main issue that arose was the length of sentences. Therefore, some of these sentences were made shorter and some of them were converted to phrases. For example, for the target consonant /d/, the original sentence was /ʧˈɒdor ru ˈdære koˈmod oˈftɒde/, ‘The scarf has been on the wardrobe’s door’. As the child in the pilot study could not repeat this ten syllable sentence, it was modified to a six syllable phrase: /ʧɒdor ru dære komod/ ‘The scarf on the wardrobe’s door’.

Another issue related to a consonant /ʒ/. This consonant is found in mainly in loan words and the occurrence of it in Farsi is limited. Therefore, to find imageable words which contain /ʒ/ and meet all the sentence restrictions was challenging. However, word /ʃufɒʒ/ was chosen for final-word target and the concept of this word is not an easy task for the children because its occurrence is limited in Farsi.

The last challenging issue related to the imagibility of the words and sentences. These might meet the phonological and morpho-syntactic criteria but, might not be imagable or meaningful to the child. Therefore, some words were replaced by words that met all the criteria including imagibilty, sound distribution and length. For example, the word /kej/ ‘when’ was not imageable for the child in the pilot study, so it was modified to /nej/ ‘straw’ in the speech sample. Appendix 4 shows the final (revised) sentence list.

### 4.4.1.4 Single words

As stated before, single word naming is included in the Farsi GOS.SP.ASS to supplement unclear data in the sentences. A 68 item picture-naming test is used as a second speech elicitation. The pictures are photographs of familiar everyday objects which are presented to each participant to elicit a naming response after sentence repetition. Appendix 4 shows the word list. It illustrates which consonant is elicited by each word and the position of the consonant in the word. The primary aim in drawing up this list is to elicit each target consonant at least once in the following positions: syllable initial word initial, syllable medial within word and syllable final within word. All 23 Farsi consonants are assessed in this speech sample. To minimize the number of syllables, the word containing the target consonant in the initial or final position has only one syllable, while the word containing the target consonant in the medial position has two syllables. Another important criterion is that all the target consonants in initial and medial positions are followed by vowels.

## 4.5 Summary

This chapter like chapters 2 and 3, presents information necessary to shape the research questions and design a relevant methodology for the current study. This chapter then presented an overview of the speech assessment protocol for Farsi-speaking children with a cleft palate, which was developed based on the GOS.SP.ASS’98 protocol for English. This chapter described the importance of a speech protocol in the assessment of speech difficulties with a focus on speech problems in children with a cleft palate. The need to develop a Farsi-specific protocol and the reasons for choosing GOS.SP.ASS’98 as a basis for the Farsi protocol were explained. Furthermore, all the speech parameters and categories which are used in the Farsi protocol, and the changes which were made to the GOS.SP.ASS’98, were described. The last part of this chapter explained how the Farsi elicitation material was constructed based on GOS.SP.ASS’98 sentences, described the challenges that were encountered when constructing the sentences and finally how the sentences were modified to be an appropriate speech sample for the Farsi version of GOS.SP.ASS. The methodology will be described in the next chapter.

# Chapter 5 Methodology

## 5.1 Introduction

The first part of this chapter presents and explains the research aims and questions of the thesis as well as the methods that are employed to address the research questions. The recruitment of participants and the collection of speech data is described, as is the process of phonetic transcription and perceptual rating carried out. In the second part of the chapter there is a description of the procedures that were used to ensure the reliability of the transcription and perceptual ratings that form the material for analysis in chapter 6 and 7.

## 5.2 Research questions

The purpose of this study is to identify speech features produced by Farsi-speaking children with cleft palate, and compare them with cleft speech characteristics that have been reported for English and other languages. Such research would be an essential prerequisite for studying the effects of cleft palate on the intelligibility of Farsi-speaking children – a topic that is beyond the scope of the present study. Although intelligibility is of great interest from a clinical perspective, doing research into the intelligibility of child speech is methodologically extremely complex (Sell, 2005), particularly where little developmental or clinical research has been carried out on the language in question (as with Farsi).

This study was designed to address the following questions that expand the questions outlined in chapter 1, page 2.

1. Research Question 1: What are the types of cleft speech characteristics in children with a cleft palate? With regard to the types of cleft speech characteristics produced by Farsi-speaking children:
2. Are oral and non-oral cleft speech characteristics found in their speech?
3. Are passive cleft speech characteristics found in their speech?
4. Are non-cleft developmental speech patterns found in their speech?
5. Are atypical realisations (i.e. realisations that are neither typical of normal development nor of cleft speech) found in their speech?
6. Is their speech affected in terms of resonance, airflow and voice?
7. Research Question 2: What are the similarities and differences between characteristics of cleft palate speech in Farsi and other languages, especially English?
8. Research Question 3: Are there any developmental speech features in the typically-developing Farsi-speaking children aged 5 to 10, as predicted by the literature on typical Farsi speech development?
9. Research Question 4: How do these features compare with speech patterns identified in other languages for children of a similar age?
10. Research Question 5: What is the relative frequency of occurrence of different cleft speech characteristics in the speech of Farsi-speaking children with cleft palate?
11. Reseach Question 6: How are different target consonants affected in the speech of Farsi-speaking children with cleft palate?
12. Research Question 7: Is the occurrence of cleft speech characteristics related to the child’s age at assessment?
13. Research Question 8: Is the occurrence of cleft and non-cleft speech characteristic related to the type of cleft that the child has?
14. Research Question 9: What are the clinical implications of the study for speech assessment in Farsi-speaking communities?

## 5.3 Study Design

In order to explore the nature of speech characteristics in the speech of Farsi-speaking children with a cleft palate, this study followed a similar type of descriptive research design as reported in other studies (Rullo *et al.,* 2008) - such as Mekonnen (2013) and Al-awaji (2014), This is a small group study employing a descriptive research design which was not aiming to test specific hypotheses about causation. The main aim of descriptive research is to describe the data and characteristics of a population being studied. Descriptive research is not about how, when or why the characteristics occurred. The primary focus of this research was to describe and consider the nature of characteristics of speech in a group of Farsi-speaking children with repaired cleft palate.

The methodology involved a perceptual phonetic and phonological analysis of the speech production of Farsi-speaking children with a cleft palate. A small study of typically-developing speech in children in the same age range as the children in the cleft palate group provided some reference data about speech characteristics of older typically-developing Farsi-speaking children, which was not available in the research literature. The results from the latter study are presented as a case series.

The study was divided into eight stages:

1. Translation of GOS.SP.ASS’98 into Farsi.
2. Development of Farsi-specific speech elicitation materials
3. Trial of the speech elicitation materials with a Farsi-speaking child
4. Amendments to materials and trial with a Farsi-speaking child
5. Recruitment of participants with and without cleft palate
6. Data collection
7. Phonetic transcription
8. Analysis and interpretation of data

Phases 1-4 have been described in Chapter 4. Phases 5 -7 are described in this chapter. Phase 8 is described in Chapters 6 -8.

## 5.4 Ethics

Prior to collection of any data, Ethics Committee approval was sought from the University of Sheffield where the researcher is studying. The parent information sheet and the consent form (appendix 2) were sent to the ethical committee for approval so that data collection could proceed. After some delay, approval was gained. A letter was submitted to the administrator at the speech therapy clinic in Iran requesting permission to approach patients from this clinic. The administrator agreed to give parents the information letters and the consent forms requested at the time of clinic attendance.

**5.4.1 Ethical considerations**

The following paragraphs provide details about the kinds of ethical issues that were considered in the development of the methodology for this study.

**5.4.1.1 Informed consent**

When doing research with children, it is necessary to obtain informed consent from the parent(s) or guardian. In this research, parent information sheets and consent forms were provided before the data collection.

**5.4.1.2 Anonymity**

The anonymity of research participants was discussed with the parents. In this project, it was necessary to make audio and video recording of the participants’ speech sample. It was explained in the parent information that only supervisors and the researcher would have access to the video and audio data and, parents were asked to sign the consent form if they agreed to use this. The children’s identities were kept anonymous and they are not referred to by their real name.

**5.4.1.3 Confidentiality and safeguarding**

The children’s speech data sets were coded numerically for the research, and no information about the participants such as names, addresses, date of birth, telephone number were kept with the recordings.

Copies of data analyses were also anonymised and kept securely in a locked cabinet in the researcher’s office and also in the first supervisor’s computer in the University of Sheffield, Department of Human Communication Sciences.

## Participants

The researcher contacted a hospital in the capital, Tehran, where the surgeon specialised in the treatment of craniofacial abnormalities. Children with cleft palate are referred there. Participants with a cleft palate were identified by the SLT at the hospital and were recruited through letters distributed inviting their child’s participation in the study. Parents who agreed to their child’s participation responded to the request. It was made clear by the speech therapist at this stage that whether the parents wanted their children to participate or not, their decision would not affect their child’s existing or future speech treatment at the clinic. If they agreed to take part in this study, an information sheet was given to them, describing the research and also what their role would be, in detail.

Altogether 26 children from Tehran were recruited to this study: 21 children with a repaired cleft palate aged between 5;0 and 10;0 years, as a ‘cleft palate’ group and, 5 typically-developing children aged between 5;0 and 10;0 years as a ‘comparator group’. All 26 children were native Farsi-speaking, resident in Iran, and did not have any known additional malformations or syndromes.

Five children without a cleft palate aged between 5;0 and 10;0 years were recruited as a comparator group. Children in Iran start official education around the age of 7. Therefore, the children without a cleft palate aged from 5;0 to 7;0 were recruited from a preschool in the Department of Rehabilitation - which is for the children of staff. Non-cleft participants aged from 7;0 to 10;0 were recruited from school - through two preschools and one school in Tehran. Parents of typically-developing children who met the criteria, were approached by their child’s teacher. Similar to the explanation given to the parents of the cleft palate group, the teacher explained to parents of the children with no cleft palate that their participation would bring no advantages or disadvantages for their child and also there would be no effect on their education provision. Afterwards, an information sheet was given them to explain the study and their role in detail.

### 5.5.1 Inclusion and exclusion criteria: Cleft palate group

The group of 21 children included all types of cleft palate ranging from bilateral complete clefts of the lip and palate to clefts of the soft palate only. Inclusionary criteria for cleft palate participants is as follows: (1) history of repaired cleft palate; (2) their first language is Farsi; (3) aged 5 to 10 years. Participants were excluded from the study if they had a severe hearing impairment, congenital syndromes or other developmental difficulties. Information about the child’s ability to carry out the speech tasks required for this reseach was a variable that could not be controlled at the time of recruitment. The minimum age of 5 years was chosen because studies in English and other languages show that children by that age obtain the phonological repertoire (Dodd *et al.,* 2003). Therefore, the possibility of interference from typical developmental phonological processes is minimised.

### 5.5.2 Inclusion and exclusion criteria: Comparator group

This group included five typically-developing children who were between 5 to 10 years old and whose first language was Farsi. They were considered to be within a normal IQ range and did not present with any medical conditions or developmental difficulties which affected their speech. According to a parent questionnaire, they should be generally developing typically, including their speech and language skills.

## 5.6 Data collection

Each participant was seen individually in a session lasting about an hour, depending on the age of the child. The speech tasks were administrated in a non-challenging way, in a supervised and professional environment. If the participants showed any sign of stress during the session, the session could be stopped immediately and they would be able to withdraw from the project at any time.

For the children with cleft palate, all data recordings were taken in the speech therapy clinic where the children were attending speech therapy intervention sessions. At the start of the visit, a brief history was taken from a parent according to the original GOS.SP.ASS protocol. This included information about the child’s health, description of the cleft at birth, the amount and time[s] of surgery, any recorded or apparent hearing loss at the time of assessment or previously, the frequency of speech therapy and also any family concerns with the child’s speech.

### 5.6.1 Recording method

The data were recorded with a high quality Sony HDR-PJ240 video recorder and Olympus VN-7800PC digital voice recorder in a quiet environment. Participants were videoed throughout the speech elicitation process with a clear view of their face and mouth in good light. A dynamic Sennheiser E-815-SX microphone was positioned approximately 15cm from the child’s mouth. Data were transferred from the recorders to a laptop and copies were saved to an external hard disk. A second copy was given to the supervisor for a safe back up.

### 5.6.2 Speech elicitation material

Development of the Farsi speech elicitation materials has been described in Chapter 4. All 23 Farsi consonants were elicited in different word positions in 23 sentences and 68 single words (Appendix 4). The test was devised to elicit all Farsi consonants in all word positions in phonetic contexts which avoided inclusion of other pressure consonants which might affect either production or perception of the target consonant.

### 5.6.3 Elicitation procedure

For the sentence repetition task, the examiner showed the picture related to the sentence to the child and said the sentence aloud. After that, the child was requested to repeat the sentence. If the child could not repeat, or repeated only part of the sentence, the examiner asked him/her to focus on the picture more and then she repeated the target sentence more slowly. If there was still no response from the child, the examiner moved to the next sentence.

In the single word task, the children were asked to name each picture in turn. If the child could not identify the picture, the examiner gave him/her semantic cues. For example, ‘’Is this a dog or cat?’’ Sometimes the target was described for a child i.e. ‘’It’s an animal and says mio mio’’. If the child still was not able to recognise the picture, direct imitation was used as a last resort, for example ‘’It’s a cat, can you say cat?’’ The same semantic cues were used consistently for all children during the data collection.

In order to address the research questions, the data collection and analysis was restricted to consonant production, nasality and nasal airflow.

## 5.7 Phonetic transcription and perceptual analysis

Data analysis was based on the GOS.SP.ASS analytical approach. Table 5.1 represents all the target consonants used in elicitation procedure.

Table 5.1 Farsi consonants (International Phonetic Alphabet (IPA), 1999, p.124).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | [Labial](http://en.wikipedia.org/wiki/Labial_consonant) | [Alveolar](http://en.wikipedia.org/wiki/Alveolar_consonant) | [Post- alveolar](http://en.wikipedia.org/wiki/Postalveolar_consonant) | [Palatal](http://en.wikipedia.org/wiki/Palatal_consonant) | [Velar](http://en.wikipedia.org/wiki/Velar_consonant) | [Uvular](http://en.wikipedia.org/wiki/Uvular_consonant) | [Glottal](http://en.wikipedia.org/wiki/Glottal_consonant) |
| [Nasal](http://en.wikipedia.org/wiki/Nasal_stop) | m | n |  |  |  |  |  |
| [Stop](http://en.wikipedia.org/wiki/Stop_consonant) | p b | t d |  |  | k ɡ | [ɢ] | ʔ |
| [Affricate](http://en.wikipedia.org/wiki/Affricate_consonant) |  |  | tʃ dʒ |  |  |  |  |
| [Fricative](http://en.wikipedia.org/wiki/Fricative_consonant) | f v | s z | ʃ ʒ |  | x |  | h |
| [Tap](http://en.wikipedia.org/wiki/Tap_consonant) |  | ɾ |  |  |  |  |  |
| [Trill](http://en.wikipedia.org/wiki/Trill_consonant) |  |  |  |  |  |  |  |
| [Approximant](http://en.wikipedia.org/wiki/Approximant_consonant) |  | l |  | j |  |  |  |

As described in chapter 4 the analysis included realisations of consonants in three different word positions: syllable initial word initial (SIWI), syllable initial within word (SIWW) and syllable final word final (SFWF). In the interests of time, only the child’s realisation of target consonants was transcribed, rather than the entire word or sentence in which it occurred. Transcription was made from the video and audio recordings by the author, using the International Phonetic Alphabet (IPA) (IPA, 1999), Extended IPA for disordered speech (ExtIPA) (Ball *et al.,* 1994). Samples that were particularly difficult to transcribe were reviewed with one of the supervisors in consensus listening meetings.

Nasality and nasal airflow scales vary between 2 and 5 points.

* *Resonance* includes the rating scale*:* this includes hypernasality and hyponasality which are rated using a 4-points and a 3- points scale respectively
* *Nasal airflow:* reflects the evidence of audible nasal emission and nasal turbulence perceived in production of voiceless pressure consonants using a 3-points rating scale.
* *Different types of Grimace:* were rated on a binary system (present vs. absent).

Voice parameters: dysphonia is rated based on a binary system (present vs. absent) and where dysphonia is rated, note is made that the resonance rating might be different if the voice had not been dysphonic or hoarse made.

## 5.8 Transcription reliability

One aspect of the methodology of the current study was to enhance the validity and to ensure the reliability of transcription and perceptual ratings used to analyse the speech of Farsi-speaking children with a cleft palate. Drawing on methods described in previous literature, two strategies were introduced. Firstly the researcher conferred with an English-speaking clinical expert in the field of cleft palate speech over challenging transcription data in consensus listening sessions. Secondly the researcher’s transcription skills were evaluated in an inter-rater reliability exercise. A specific listening protocol was developed to train a second Farsi-speaking SLT in cleft speech transcription. The second transcriber subsequently completed Farsi GOS.SP.ASS assessments on two of the 21 data sets. This listening protocol was followed by the author and a second transcriber.

### 5.8.1 The second transcriber

A member of the Department of Speech and Language Therapy at Iran University, Tehran was invited to carry out transcription with the aim of assessing the reliability of the transcription done by the main investigator in this study. The second transcriber is a native speaker of Farsi and a qualified speech and language therapist with experience in phonetic transcription for clinical purposes. In preparation for fulfilling the inter-rater reliability tasks she completed a training programme developed by the researcher based on the CAPS-A (John *et al*., 2006) listening guidelines.

### 5.8.2 The training material

A training DVD was compiled with a series of video clips taken from the Farsi data providing examples of a range of specific features of speech to correlate with cleft speech characteristics as described in GOS.SP.ASS. This was accompanied by a written description (presented on Powerpoint) of those specific cleft speech characteristics. These examples of GOS.SP.ASS (Sell *et al.,* 1999) cleft speech characteristics were selected from the Farsi-speaking video data. The video examples in the training materials included different degrees of nasal resonance, a range of nasal emission, nasal turbulence, and grimace as well as the following cleft speech characteristics:

Dentalisation/interdentalisation

Lateral articulation/lateralisation

Palatal articulation/palatalisation

Double articulation

Backing to velar/uvular place of articulation

Pharyngeal articulation

Glottal articulation

Nasal fricatives

Weak/nasalised consonants

Nasal realisation of plosives/fricatives

Gliding of fricatives/affricates.

The examples on the listener training DVD were first transcribed by the author, then checked in a consensus listening exercise with one of her supervisors, who is a clinical expert in the field of cleft palate with extensive experience transcribing the speech of English-speaking children with a cleft palate. Unambiguous prototypical examples were chosen jointly by the investigator and the supervisor as training material.

In addition, the English training video from the GOS.SP.ASS’98 (Great Ormond Street Speech Assessment) was sent to the second transcriber so that she could observe and study the cleft speech characteristics. This training video provides examples and opportunities to practise transcription of the cleft speech characteristics.

The Iran-based transcriber completed her training within a month and proceeded to the transcription task as outlined below. She was provided with listening guidelines which allowed her to refer to the written material in the Powerpoint presentations as frequently as necessary but limited the number of times she should listen to each target sound to a maximum of four times. Afterwards, the author contacted the Iran-based second transcriber in case she had questions about the transcription process.

### 5.8.3 Inter-rater reliability exercise

After completion of the training phase, speech samples from two children in the cleft group were sent to the Iran-based transcriber for the reliability exercise. As many studies in cleft palate use 10% of the total speech sample to investigate the reliability of transcription (Shriberg & Lof, 1991; Campbell *et al.,* 2003; Tyler *et al.,* 2011; Lohmander *et al.,* 2011), a speech sample was taken from 2/21 data sets for this study. In order to select the two most suitable speech samples from the 21 that had been collected and transcribed, all the speech data was reviewed by the main researcher. As noted earlier, some of the data sets showed few errors, and some of them had very difficult errors. Careful consideration was given to selecting data with the most appropriate level of difficulty for the reliability exercise, given the constraints of conducting this exercise remotely. With this in mind, two speech samples, which were judged to be neither too simple nor too challenging, were chosen for transcription. This middle range of severity avoided disagreements about features of speech that would be unlikely to occur in other speakers with cleft palate and might have biased the reliability results.

The two video-recorded speech samples that were sent to the Iran-based second transcriber consisted of sentence repetition data, which were the main type of data analysed in this project.

### 5.8.4 The transcription process

The second transcriber was instructed to use high-quality headphones while viewing the video of the two speech samples during the transcription exercise. She was asked to make narrow phonetic transcriptions of the target consonants in each sentence by using the International Phonetic Alphabet symbols (IPA), ExtIPA symbols that are used for speech impairments (ExtIPA) and Voice Quality Symbols (VoQS) to transcribe the specific target within an utterance. As noted above, she was instructed not to listen to each phrase more than four times on any one occasion.

### 5.8.5 Analysis of transcription reliability

Taking account of the limitations of the point-to-point method, this study used the procedure recommended by John *et al.,* (2006) and Sell *et al.,* (2009). Inter-rater reliability in the procedure is based on clearly-specified summary categories thereby avoiding the need to agree precise phonetic transcription. The procedure was adopted in the current study with some adaptations. The reliability rating consists of six parts each reflecting one parameter of speech. The speech parameters are resonance, nasal airflow, voice, nasal turbulence, grimace and cleft speech characteristics. On the sheet to be completed by the transcriber, each speech parameter includes scalar points and its description.

For the purposes of comparison of inter-rater reliability between the author and the second transcriber, each of the twelve cleft speech characteristics was assigned a rating according to the number of consonants affected by that particular CSC as used for reporting speech outcomes in the CAPS-A (John *et al*., 2006):

1) 0 =Absence of this specific CSC,

2) 1 =Two, or less than two, consonants that are affected by this CSC

3) 2 = Three or more consonants affected by this specific CSC.

### 5.8.6 Results

The inter-rater reliability exercise was based on the comparison between the findings of two speech data sets (one per child) showing the summarised results of different levels of transcription agreement achieved. As instructed, firstly, the two transcribers transcribed specific target sounds in the sentences. Secondly, their transcriptions of the child’s realisations of the targets were put in the summarised categories. Table 5.2 and 5.3 show the difference and similarities in the transcription of the CSCs for child 1 and 2.

### 5.8.6.1 Consonant transcription agreement

Table 5.2 Agreement between two transcribers for child 1

|  |  |  |
| --- | --- | --- |
| Child 1 | Transcriber 1 | Transcriber 2 |
| **Anterior Oral CSCs** | | |
| Dentalisation/Interdentalisation | 0 | 0 |
| Lateralisation/Lateral articulation | 0 | 0 |
| Palatalisation/Palatal articulation | 2 | 2 |
| Double articulation | 0 | 0 |
| **Posterior Oral CSCs** | | |
| Backing to velar/uvular | 0 | 0 |
| **Non-oral CSCs** | | |
| Pharyngeal articulation | 1 | 0 |
| Glottal articulation | 2 | 2 |
| Active nasal fricative | 2 | 2 |
| **Passive CSCs** | | |
| Weak/nasalised consonants | 1 | 1 |
| Nasal realisation of plosives/fricatives | 2 | 2 |
| Gliding of fricatives/affricates | 0 | 0 |

Table 5.3 Agreement between two transcribers for child 2

|  |  |  |
| --- | --- | --- |
| Child 2 | Transcriber 1 | Transcriber 2 |
| **Anterior Oral CSCs** | | |
| Dentalisation/Interdentalisation | 0 | 0 |
| Lateralisation/Lateral articulation | 1 | 1 |
| Palatalisation/Palatal articulation | 2 | 2 |
| Double articulation | 1 | 1 |
| **Posterior Oral CSCs** | | |
| Backing to velar/uvular | 0 | 0 |
| **Non-oral CSCs** | | |
| Pharyngeal articulation | 0 | 0 |
| Glottal articulation | 2 | 2 |
| Active nasal fricative | 0 | 0 |
| **Passive CSCs** | | |
| Weak/nasalised consonants | 2 | 1 |
| Nasal realisation of plosives/fricatives | 2 | 2 |
| Gliding of fricatives/affricates | 2 | 2 |

In child 1, although there is a disagreement of result in pharyngeal articulation, 100% agreement is observed in the other CSCs including posterior oral CSCs and passive, CSCs. In child 2, the only disagreement is in the transcription of passive weak/nasalised CSCs. Tables 5.4 and 5.5 present disagreements between two transcribers.

Transcribers’ disagreements are shown in table 5.4 and 5.5.

Table 5.4 The disagreements between two transcribers for child 1

|  |
| --- |
| **Non-oral CSCs** |
| Transcriber 1: /x/ → [ħ] in SIWI/ the word is /xɒle/ |
| Transcriber 2: /x/ → /x/ in SIWI/ the word is /xɒle/ |

Table 5.5 The disagreement between two transcribers for child 2

|  |
| --- |
| **Passive CSCs** |
| Transcriber 1: /x/ → [x͉] in SFWF / the word is /jӕx/ |
| Transcriber 2: /x/ → /x/ in SFWF / the word is /jӕx/ |

### 5.8.6.2 Resonance rating agreement

The result of agreement between two transcribers for two children in terms of resonance, airflow, voice and grimace is presented in the tables below.

Table 5.6 Agreement between the two transcribers for child 1

|  |  |  |  |
| --- | --- | --- | --- |
| Child 1 | Transcriber 1 | Transcriber 2 | (%) of agreement |
| Hypernasality | 3 | 3 | 100% |
| Hyponasality | 0 | 0 | 100% |
| Nasal emission | 1 | 1 | 100% |
| Nasal turbulence | 0 | 0 | 100% |
| Grimace | 0 | 0 | 100% |
| Voice | 0 | 0 | 100% |

Table 5.7 Agreement between the two transcribers for child 2

|  |  |  |  |
| --- | --- | --- | --- |
| Child 2 | Transcriber 1 | Transcriber 2 | (%) of agreement |
| Hypernasality | 1 | 1 | 100% |
| Hyponasality | 0 | 0 | 100% |
| Nasal emission | 0 | 0 | 100% |
| Nasal turbulence | 0 | 0 | 100% |
| Grimace | 1 | 1 | 100% |
| Voice | 0 | 0 | 100% |

Based on the tables, 100% agreement for the two transcribers was achieved for resonance, airflow, grimace and voice. It should be noted that the reliability assessment was done for only two children. Therefore, no statistical test can be carried out. Instead, the ratings of the two raters were compared for different variables which are hypernasality, hyponasality, nasal emission, nasal turbulence, grimace and voice.

## 5.9 Summary

In this chapter the research questions and design of the study have been outlined. The method and protocol have been described with information about the process of transcribing Farsi cleft speech and of establishing the reliability of transcription. The consistent agreement across all the parameters for 10% of the research data indicates satisfactory reliability, meaning that the researcher is able to carry out the rest of the data transcription independently. Where specific extracts of data were particularly difficult to transcribe the researcher conferred with her English-speaking experienced listener and transcription was agreed by consensus listening. The transcriptions obtained in this way form the data for the analysis presented in the following chapters.

# Chapter 6 Results of speech analysis for typically-developing children

## 6.1 Introduction

To understand the patterns of speech production that are used by children with a cleft palate in any language, the researcher and clinician should be familiar with the normal patterns of speech production in typically-developing children at different stages of development. As mentioned in chapter 4, few studies relating to normal speech development have been conducted in Farsi. Therefore, speech production of a small group of typically-developing, Farsi-speaking children was analyzed in this study to provide comparison between cleft palate and typically-developing children. This was a way of investigating the specificity of the Farsi version of the GOS.SP.ASS. The hypothesis was that the sentence stimuli would be pronounced with adult pronunciation by Farsi-speaking children without a cleft palate, whereas children born with a cleft palate were expected to demonstrate some unusual, cleft-related speech characteristics. The process of collecting typical Farsi speech data also served as an opportunity to try out the methodology for speech data collection with the cleft palate cases.

This chapter presents the results of the perceptual phonetic and phonological analysis of the speech production of typically developing Farsi-speaking children aged 5 to 10 years in order to provide data for comparison with data from children with the cleft palate.

The aims of this part of the study are to address research questions three and four:

* Research Question 3: Are there any developmental speech features in the typically-developing Farsi-speaking children aged 5 to 10, as predicted by the literature on typical Farsi speech development?
* Research Question 4: How do these features compare with speech patterns identified in other languages for children of a similar age?

Table 6.1 shows the gender of the children and their age (in years and months).

Table 6.1 Gender and age of children in the typically-developing group

|  |  |  |
| --- | --- | --- |
| Name | Gender | Age |
| Nima | Male | 5;10 |
| Sepanta | Male | 6;7 |
| Bardia | Male | 7;0 |
| Mahtisa | Female | 8;1 |
| Mahdieh | Female | 9;11 |

## 6.2 Results for individual children

The age of acquisition of consonants in the speech of typically-developing children who speak Farsi are summarised in table 6.2 which shows this information that was reported in 2.11.1.

|  |  |  |
| --- | --- | --- |
| Table 6.2 Order of consonant acquisition in Farsi-speaking children | | |
| ***Age*** | ***Consonant*** |  |
| 12-17m | /d, t, m, n, ʔ, k, h, p, b, j, l/ |  |
| 18-23m | /x, ɡ, ʧ, ʃ, ʤ, s, z/ |  |
| 24-29m | /f, v, ɾ, G/ |  |
| 36-42m | /ʒ/ |  |

The consonant production results for the five typically-developing children in the present study are presented individually in Tables 6.3 to 6.8. Divergences from the adult target are highlighted in **bold** and blue colour.

### 6.2.1 Nima (CA 5;10)

Some residual developmental speech features were observed in the speech of Nima. Most of his different realisations were observed in the final position of the syllable at the end of sentences. For example, he realised voiceless plosive [p] for voiced plosive /b/ in the sentences. All these realisations are shown in bold in table 6.3.

Table 6.3 Consonant production: Nima

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Place | Bilabial | | | | | Alveolar | | | | | | | Post-Alveolar | | | | Palatal | Velar | | | Uvular | Glottal | |
| target | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWI | m | p | b | f | v | n | l | t | d | s | z | **l** | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWW | m | p | b | f | v | n | l | t | d | s | z | **l** | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SFWF | m | p | **p** | f | v | n | l | t | d | s | z | **l** | ʃ | ʒ | ʧ | ʤ | j | **ʧ** | ɡ | **Ø** | G |  | h |

The phonological simplification processes which were noted in the speech of Nima, are presented in table 6.4. One of the developmental phonological processes, which was observed in the speech of Nima in both elicitation modes, i.e. single words and sentences, was fronting. Although he realised the velar plosive /k/ in the SIWI and SIWW positions accurately, he produced /k/ as a post alveolar affricate [ʧ] in the SFWF position and single word /piʧ/. It is interesting that substitution of [l] for /r/ was observed in all word positions in the sentences and single word consistently, even though Damirchi (2008) stated that 90% of the Farsi-speaking children can produce /r/ by 5 years.

Table 6.4Developmental phonological processes and specific patterns in the speech of Nima

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phonological process | Pattern | Target | Realisation | Gloss | position |
| Fronting (velar to alveolar) | /k/→ [ʧ] | /xuk/ | [xuʧ] | Pig | SFWF  Single word |
| Substitution of /ɾ/ | /ɾ/→[l] | /ɾæfˈte/  /suˈɾɒx/  /mɒɾ/ | [læfte]  [sulɒx]  [mɒl] | Has gone  Hole  Snake | SIWI  SIWW  SFWF and single word |

### 6.2.2 Sepanta (CA 6;7)

As shown in table 6.5, there are some realisations in Sepanta’s speech that did not match adult Farsi speech - such as production of [ʃ] instead of /ʒ/. This has been described as a typical realisation in Farsi-speaking children (Damirchi, 2008). In addition, /t/ is aspirated in the final position of the syllable which is supported by the structure of Farsi phonology: allophonic variants are observed in production of the alveolar plosives /t, d/, which are aspirated at the end of the syllable (International Phonetic Association, 1999).

Table 6.5 Consonant realisations in the Sepanta’s speech

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Place | Bilabial | | | | | Alveolar | | | | | | | Post-Alveolar | | | | Palatal | Velar | | | Uvular | Glottal | |
| target | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWI | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWW | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SFWF | m | p | b | f | v | n | l | **tʰ** | **Ø** | s | z | r | ʃ | **ʃ** | ʧ | **d** | j | k | ɡ | x | G |  | h |

Developmental phonological processes noted in Sepanta’s data are final consonant deletion and deaffrication. Examples of each process are presented in table 6.6. Final consonant deletion was observed in both single word production and sentence repetition while deaffrication was observed only in sentence repetition in SFWF position for one consonant target.

Table 6.6 Developmental phonological processes and specific patterns in the speech of Sepanta

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phonological process | Pattern | Target | Realisation | Gloss | Position |
| Final consonant deletion | /d/→ [Ø] | /komod/ | [komo] | Wardrobe | SFWF |
| Deaffrication | /ʤ/→[d] | /kæʤ/ | [kæd] | Messy | SFWF |

### 6.2.3 Bardia (CA 7;0)

As shown in table 6.7, Bardia presented with some non-adult realisations in his speech. It is notable that all the fricative and affricate consonants that are post alveolar in Farsi, i.e. /ʃ, ʒ, ʧ, ʤ/, were realised as alveolar in both single words and sentences. He also realised voiced alveolar plosive [d] for voiceless alveolar plosive /t/ for only one position (SFWF).

Table 6.7 Consonant realisations in the speech of Bardia

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Place | Bilabial | | | | | Alveolar | | | | | | | Post-Alveolar | | | | Palatal | Velar | | | Uvular | Glottal | |
| target | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWI | m | p | b | f | v | n | l | t | d | s | z | r | **s** | **z** | ʧ | **d** | j | k | ɡ | x | G | ʔ | h |
| SIWW | m | p | b | f | v | n | l | t | d | s | z | r | **s** | **z** | **t** | **d** | j | k | ɡ | x | G | ʔ | h |
| SFWF | m | p | b | f | v | n | l | **d** | d | s | z | r | **s** | **z** | **t** | **d** | j | k | ɡ | x | G |  | h |

The phonological processes which Bardia used in his speech were de-affrication and fronting. Although fronting typically disappears around 3;9 years in the speech of children who speak English (Grunwell, 1987) and around 2;6 years in Farsi-speaking children (Damirchi, 2008), he used this substitution in production of all post-alveolar sounds in single words and sentences. Furthermore, use of the de-affrication process was observed in the production of /ʧ/ in single word, SIWW and SFWF positions. All the developmental phonological process and patterns that he used in his speech are shown in table 6.8.

Table 6.8 Developmental phonological processes and specific patterns in Bardia’s speech

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phonological process | Pattern | Target | Realisation | Gloss | Position |
| Fronting  (post-alveolar to alveolar) | /ʃ/→[s] | /ʃæb/  /mɒʃin/  /muʃ/ | [sæb]  [mɒsin]  [mus] | Night  Car  Mouse | SIWI  Single word  SIWW  Single word  SFWF  Single word |
| Deaffrication | /ʧ/→[t] | /bæʧe/  /piʧ/ | [bate]  [pit] | Child  Screw | SIWW  Single word  SFWF  Single word |

### 6.2.4 Mahtisa (CA 8;1)

There are some realisations in the speech of Mahtisa which are illustrated in table 6.9. Similar to Bardia, some of post-alveolar consonants were realised as alveolars, such as /ʃ/→[s] in all speech samples or /ʤ/→[d].

Table 6.9 Consonant realisations in the speech of Mahtisa

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Place | Bilabial | | | | | Alveolar | | | | | | | Post-Alveolar | | | | Palatal | Velar | | | Uvular | Glottal | |
| target | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWI | m | p | b | f | v | n | l | t | d | s | z | r | **s** | ʒ | ʧ | **d** | j | k | ɡ | x | G | ʔ | h |
| SIWW | m | p | b | f | v | n | l | t | d | s | z | r | **s** | ʒ | **t** | **d** | j | k | ɡ | x | G | ʔ | h |
| SFWF | m | p | **p** | f | v | n | l | t | d | s | z | r | **s** | ʒ | **ʃ** | ʤ | j | k | ɡ | x | G |  | h |

Developmental phonological processes used in Mahtisa’s speech are deaffrication and fronting. She demonstrated deaffrication processes in production of affricates, /ʧ, ʤ/ in SIWI and SIWW positions. Fronting was another phonological process that she used in her speech. She pronounced [s] instead of /ʃ/ consistently in all contexts and positions. Therefore, no variation conditioned by elicitation manner or context was found. It is uncommon that an 8;1 year-old child uses this phonological process which should disappear by age 2;6 based on Farsi literature (Damirchi, 2008). The phonological processes which are persistently used by Mahtisa are shown in table 6.10 below.

Table 6.10 Developmental phonological processes and specific patterns in Mahtisa’s speech

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phonological process | Pattern | Target | Realisation | Gloss | Position |
| Fronting  (post alveolar to alveolar) | /ʃ/→[s] | /ʃæb/  /mɒʃin/  /muʃ/ | [sæb]  [mɒsin]  [mus] | Night  Car  Mouse | SIWI  Single word  SIWW  Single word  SFWF  Single word |
| Deaffrication | /ʧ/→[t] | /bæʧe/ | [bate] | Child | SIWW |

### 6.2.5 Mahdieh (CA 9;11)

According to table 6.11, which shows consonant realisations in the speech of Mahdieh, her sound system was mature. Her realisation of /ʒ/ as [ʤ] was limited to one position (SFWF). Among adult speakers of English there are variations between fricative and affricate sounds in certain loan words, originally borrowed from French, which allows the word final voiced post-alveolar fricative to be interchangeable with the voiced post-alveolar affricate in this context (Gimson, 1989). This realisation may also occur in Farsi because /ɡɒrɒɡ/ is a loan word in Farsi too. Otherwise, in comparison with the other four participants, Mahdieh produced all the Farsi consonants appropriately.

Table 6.11 Consonant realisations in the speech of Mahdieh

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Place | Bilabial | | | | | Alveolar | | | | | | | Post-Alveolar | | | | Palatal | Velar | | | Uvular | Glottal | |
| target | m | p | b | f | v | n | l | t | d | s | z | r | ʃ | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWI | m | p | b | f | v | n | l | t | d | s | z | r |  | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SIWW | m | p | b | f | v | n | l | t | d | s | z | r |  | ʒ | ʧ | ʤ | j | k | ɡ | x | G | ʔ | h |
| SFWF | m | p | b | f | v | n | l | t | d | s | z | r |  | **ʤ** | ʧ | ʤ | j | k | ɡ | x | G |  | h |

## 6.3 Summary of consonant realisations in the speech of typically-developing children

Table 6.12 shows non-adult consonant realisations in the speech of all typically-developing children.

Table 6.12 Different realisations in the speech of all typically-developing children

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| Nima | 5;10 | /ʧ/→[k] | /piʧ/ | [pik] | SFWF  Single word | ‘screw’ |
| /b/ →[p] | /tɒb/ | [tɒp] | SFWF | ‘swing’ |
| /**r**/ →[**l]** | /ræf'te/  /su'rɒx/  /mɒr/ | [**l**æf'te]  [su**l**ɒx]  [mɒ**l]** | SIWI  SIWW  SFWF | ‘has gone’  ‘hole’  ‘snake’ |
| /x/ → [Ø] | /jæx/ | [jæ] | SFWF | ‘ice’ |
| Sepanta | 6;7 | /t/ → [**tʰ]** | /ketɒbet/ | [ketɒbe **tʰ]** | SFWF | ‘your book’ |
| /d/ →[**Ø]** | /komod/ | [komo] | SFWF | ‘wardrobe’ |
| /ʒ/ → [**ʃ]** | /ʃufɒʒ/ | [ʃufɒ**ʃ]** | SFWF | ‘heater’ |
| /ʤ/ → [d] | /kæʤ/ | [kæd] | SFWF | ‘slant’ |
| Bardia | 7;0 | /t/ → [d] | /ketɒbet/ | [ketɒbed] | SFWF | ‘your book’ |
| /ʃ/ → [s] | /ʃæb/  /mɒʃin/  /muʃ/ | [sæb]  [mɒsin]  [mus] | SIWI  SIWW  SFWF | ‘night’  ‘car’  ‘mouse’ |
| /ʒ/ → [z] | /ʒɒkete/  /ʃufɒʒ/ | [zɒkete]  [ʃufɒz] | SIWI  SIWW | ‘jacket’  ‘heater’ |
| /ʧ/ → [t] | /bætʃe/  /piʧ/ | [bæte]  [pit] | SIWW  SFWF | ‘child’  ‘screw’ |
| /ʤ/ → [d] | /ʤibe/  /mæʤid/  /kæʤ/ | [dibe]  [mædid]  [kæd] | SIWI  SIWW  SFWF | ‘pocket’  ‘name’  ‘slant’ |
| Mahtisa | 8;1 | /b/ →[p] | /tɒb/ | [tɒp] | SFWF | ‘swing’ |
| /ʧ/ → [t] | /bætʃe/ | [bæte] | SIWW | ‘child’ |
| /ʤ/ → [d] | /ʤibe/  /mæʤid/ | [dibe]  [mædid] | SIWI  SIWW | ‘pocket’  ‘name’ |
| Mahdieh | 9;11 | /ʒ/ → [ʤ**]** | /ʃufɒʒ/ | [ʃufɒʤ**]** | SFWF | ‘heater’ |

## 6.4 Summary of phonological patterns used by typically-developing participants

Normal developmental phonological processes are those patterns normally identified in the speech of typically-developing children at any given age and stage of development. They are predictable pronunciation patterns and immaturities at the appropriate age and so they are called normal developmental as distinct from atypical phonological processes (Grunwell, 1997; Bowen, 2009). Phonological simplification processes generally constrain a child’s range of meaningful contrasts between sounds. These phonological simplifying processes are categorised as either structural simplifications or systemic simplifications (Grunwell, 1982).

A summary of developmental phonological patterns found in the speech of these five typically- developing participants is presented here.

### 6.4.1 Final consonant deletion in utterance final position

Final consonant deletion, which is a structural simplification, refers here to the deletion of the final consonant in a syllable or word (Grunwell, 1982; 1997; Bowen, 1998; Miccio & Scarpino, 2008). The final consonant deletion pattern was observed in the speech of one typically-developing child, one occurrence for one consonant target in the child, in this research. Grunwell (1982) and Bowen (1998) state that this pattern typically disappears by 3;3 to 3;6 years in the speech of English-speaking children. Furthermore, Damirchi (2008) shows in her study that the final consonant deletion pattern typically disappears by 3;0 to 3;6 years in the speech of Farsi-speaking children. Sepanta (6;7), in this study, demonstrated using this process in SFWF position when he was repeating the sentences. Therefore, he could produce the target consonant /d/ in the single word /komod/, but in a more complex utterance of 7-9 syllables his output processing may have temporarily regressed back to using a simplification process.

### 6.4.2 Post-alveolar Fronting

Fronting is a systemic simplification that takes place when the target should be produced further back in the oral cavity. It is a common pattern in English-speaking children (Grunwell, 1982). This process was observed in the speech of one of the typically-developing participants. Mahtisa (8;1) demonstrated fronting consistently. She realised [s] instead of /ʃ/ in all different positions of syllables includes SIWI, SIWW and SFWF in repetition of sentences. This realisation was observed in producing single words too. It is one type of fronting that occurs when post-alveolar fricatives /ʃ, ʒ/ are replaced by alveolar fricatives [s] or [z] respectively (Bowen, 1998). Since this pattern would usually have disappeared years earlier in typically-developing children who speak English (Grunwell, 1997; Bowen, 1998) and in Farsi-speaking children (Damirchi 2008) this persisting immaturity might be an indication or some articulatory irregularity.

### 6.4.3 Deaffrication

Deaffrication refers a systemic simplification pattern whereby affricate targets, which are realised as either plosives or fricatives. This pattern is common in the typical development of English-speaking children (Grunwell, 1982; Edwards & Shriberg, 1983; Ingram, 1989) and Farsi-speaking children (Damirchi, 2008). Deaffrication was observed in the speech of three participants: Sepanta (6;7), Bardia (7;0) and Mahtisa (8;1). All substituted alveolar plosives [t, d] for affricates /ʧ, ʤ/. Sepanta (6;7) and Mahtisa (8;1) only used it in one position each, SFWF and SIWW, respectively, while Bardia used it consistently in different positions included SIWW, SFWF in sentences and single words.

### 6.4.4 Substitution of /ɾ/

Although there is not a specific study on production of the alveolar tap in Farsi, it is observed in many children that they substitute an alveolar lateral approximant [l] for an alveolar tap /ɾ/. This type of systemic process has been reported in many languages such as Portuguese (Yavas & Lamprecht, 1988), and Spanish (Carballo & Mendoza, 2000). It has been observed in English that acquisition of the pronunciation of /ɾ/ is slightly late (Hayward, 2000; Howard & Heselwood, 2002). The only child who realised approximant [l] instead of /ɾ/ consistently in all contexts, was Nima (5;10). Moreover, he was the youngest of the typically-developing participants in this study.

### 6.4.5 Word final devoicing

This refers to a final voiced consonant which is replaced by a voiceless consonant in the word (Bowen, 1998). Three children, Nima (5;10), Sepanta (6;7) and Mahtisa (8;1) used this systemic process in their speech. Both Nima and Mahtisa produced [p] instead of /b/ in the SFWF position when they were repeating the sentence. One of the children, Sepanta, consistently substituted final voiceless consonant [ʃ] for voiced /ʒ/ in two different speech contexts, /ʃufɒʒ/ utterance final in the sentence and /ɡɒrɒʒ/ in a single word utterance. The International Phonetic Association (1999) and Mahootian (1997) reported that plosive and fricative consonants such as /b, d, g, z, ʒ/ are slightly devoiced in the word final position in adult production in Farsi. These types of pronunciations are common in adults’ production in Farsi similar to many languages such as English (Harris, 1994) and German (Brockhaus, 1995). Therefore, this sort of production in the speech of Farsi-speaking children could not be considered as an inappropriate or atypical realisation.

## Summary

In this chapter, two research questions have been addressed.

Are there any residual developmental speech features in the typically-developing Farsi-speaking children, as predicted by the literature on typical Farsi speech development?

Most prevalent speech features observed in the speech of the typically-developing children in this group were occasional occurrences of normal immature patterns: final consonant deletion, fronting, deaffrication, word final devoicing and substitution of /l/ for /ɾ/. All these patterns are considered by Damirchi (2008) to be typical-developmental and persisting-developmental patterns in Farsi.

How do these features compare with speech patterns identified in other languages for children of a similar age?

Most of these speech features are similar to ones reported as normal developmental patterns in English and other languages. However some differences were demonstrated. For example, substitution of /ɾ/ realised as [l], which commonly occurs in the speech of typically-developing Farsi-speaking children, is rare in English because the target in English is a post-alveolar approximant (not a trill) and it tends to be realised by young children as [w].

As a conclusion, there were no unusual or atypical realisations, and that most of the immaturities found were later to resolve in normal speech development and not prevalent or disruptive to intelligibility in any speech sample. Therefore, where these patterns are found in the data from participants in the same age range with a history of cleft palate, as reported in the next chapters, they can be considered as developmental immaturities rather than cleft speech characteristics. Nevertheless, it is important to be cautious about assuming that these five children will go on to have typical adult speech and, therefore, that their non-adult realisations are examples of typical later speech development in Farsi.

# Chapter 7 Results of speech analysis for Farsi-speaking children with cleft palate

## 7.1 Introduction

The primary aim of this study is to identify all the different cleft speech characteristics in the speech of Farsi-speaking children and to identify any noteworthy similarities and differences between Farsi with other languages, particularly English. It was anticipated that detailed information about the cleft speech characteristics in the speech of Farsi-speaking children would facilitate interpretation of existing and future data in this and other studies.

This chapter shows the results of phonetic and phonological analysis of the perceptual speech assessments of children with a cleft palate who speak Farsi. This analysis draws on established theoretical frameworks in order to compare the speech of children with a cleft palate with the speech of typically-developing children and adults who speak Farsi. The main focus in this chapter is on describing and exemplifying the cleft speech features that were identified in the speech samples, rather than on examining the prevalence of features across the group or the impact of these features on the phonological system of individual children.

Research Question 1 is addressed in this chapter:

* What are the types of cleft speech characteristics in children with a cleft palate who speak Farsi? With regard to the types of cleft speech characteristics produced by Farsi-speaking children:

1. Are oral and non-oral cleft speech characteristics found in their speech?
2. Are passive cleft speech characteristics found in their speech?
3. Are non-cleft developmental speech patterns found in their speech?
4. Are atypical realisations (i.e. realisations that are neither typical of normal development nor of cleft speech) found in their speech?
5. Is their speech affected in terms of resonance, airflow and voice?

The first subquestions take account of consonant production as reflected in the cleft speech characteristics (CSCs), non-cleft developmental realisations and newly identified cleft speech characteristics features that may be specific to Farsi. The last subquestion considers the degree and the effects of nasal resonance and airflow, including hypernasality, hyponasality, nasal emission and nasal turbulence as well as information about grimace and voice quality. In order to address the primary aims and the supplementary aims, speech data has been charted in relation to individual speakers and subsequently examined for occurrences of each speech characteristics in GOS.SP.ASS’98. Consonant realisations in the speech of children with a cleft palate are presented in chapter 7, and then evidence of each speech characteristic is reported in chapter 8.

Table 7.1 Demographic data on the 21 children with a cleft palate

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Participants | Gender | Age at assessment | Cleft type |
| 1 | AM.E | M | 5;0 | UCLP |
| 2 | HD.M | F | 5;0 | UCLP |
| 3 | AM.H | M | 5;1 | BCLP |
| 4 | H.S | M | 5;1 | ICP |
| 5 | D.M | M | 5;2 | BCLP |
| 6 | A.R | F | 5;3 | ICP |
| 7 | M.A | M | 5;4 | BCLP |
| 8 | A.ML | M | 5;4 | UCLP |
| 9 | MH.N | M | 5;9 | BCLP |
| 10 | P.D | M | 5;9 | UCLP |
| 11 | AM.M | M | 5;11 | UCLP |
| 12 | M.H | M | 6;1 | BCLP |
| 13 | R.E | F | 6;1 | ICP |
| 14 | M.N | M | 6;3 | ICP |
| 15 | F.R | F | 7;1 | BCLP |
| 16 | M.R | M | 7;3 | ICP |
| 17 | AS.R | M | 7;8 | UCLP |
| 18 | N.F | F | 8;1 | ICP |
| 19 | K.SH | F | 8;4 | UCLP |
| 20 | R.N | M | 9;4 | UCLP |
| 21 | M.G | M | 9;9 | UCLP |

## 7.2 Consonants

As described in chapter 5, video data was transcribed with narrow phonetic transcription based on International Phonetic Alphabet (1993, revised 2005) and EXT IPA (1991, revised 2002). Data was subsequently analyzed using a modified version of the GOS.SP.ASS consonant production chart (Sell *et al.,* 1999) incorporating Farsi as explained in chapter 6. The chart was extended to include phonetic and phonological characteristics of Farsi.

The charted data was categorised according to the Farsi version of GOS.SP.ASS cleft speech categories (Sell *et al.,* 1999). Each non-adult consonant realisation was categorised as one of the following:

Anterior oral cleft-type speech characteristic;

Posterior oral cleft-type speech characteristic;

Non-oral cleft-type speech characteristic;

Passive cleft-type speech characteristic;

Non-cleft developmental realisation.

### 7.2.1 Cleft speech characteristics

Atypical articulatory gestures and unusual airflow direction might be used when attempting consonant targets, giving rise to cleft speech characteristics (CSCs). Some cleft speech characteristics are assumed to be the result of compensatory strategies that the individuals with a cleft palate use in their speech and some are the passive consequence of velo-pharyngeal dysfunction (VPD). As described in chapter 4, for this study cleft speech characteristics have been grouped into the same categories as GOS.SP.ASS, i.e. anterior, posterior, non-oral and passive cleft palate characteristics. The anterior and posterior categories include cleft-type characteristics produced within the oral cavity. The non-oral category includes cleft speech characteristics produced outside the oral cavity, i.e. pharyngeal, glottal and nasal fricative articulations. As described in chapter 4, some additional parameters identified in studies of other languages such as Arabic (Al-awaji, 2014) and Amharic (Mekonnen, 2013) have been added to the list of GOS.SP.ASS cleft speech characteristics.

As mentioned in chapter 4, anterior characteristics include primary and secondary articulations. Primary articulation refers to a realisation of the target consonant which changes one or more of the place, manner and voicing of the target. An example is a child’s voiceless palatal plosive articulation for a target voiceless velar plosive. Secondary articulations occur where the primary place and manner of the target consonant are retained but are accompanied by the secondary articulation which makes a minor phonetic variation to the target consonant. An example is palatalisation accompanying the alveolar realisation of a target alveolar plosive. Anterior characteristics include linguolabial, interdental, lateral, palatal and double articulation, as well as interdentalisation, lateralisation and palatalisation. Double articulation is defined as when there are two simultaneous places of articulation of the same degree of stricture in the oral cavity such as [t͡k] or [d͡ɡ].

Posterior realisations refer to backed articulation of target anterior consonants.Backing within the oral cavity is subcategorised into backing to velar and backing to uvular. Non-oral cleft speech characteristics consist of pharyngeal, glottal and active nasal fricative articulation of target oral consonants, as well as double articulation. Double articulation as a non-oral characteristic refers to two simultaneously released places of articulation where one is in the oral cavity and the other is non-oral, such as [b͡ʔ] or [d͡ʔ].

All the preceding realisations are assumed to be articulated actively as substitutions for target speech sounds. In contrast, passive cleft speech characteristics describe realisations where the articulatory gestures are accurate but the intended pressure or airflow direction is not achieved e.g. /b, d/ → [m, n] or [b͉͂, d͉͂] (Harding & Grunwell, 1996). Passive CSCs include weak/nasalized consonants, nasal realisation of fricatives, nasal realisation of plosives, absent pressure consonants and gliding of fricatives or affricates.

### 7.2.1.1 Anterior oral cleft speech characteristics

Theoral anterior cleft speech characteristics observed in the present data are described in turn in the following sections.

### 7.2.1.1.1. Linguolabial articulation

This CSC has been added to the GOS.SP.ASS’98 CSCs as explained in chapter 4. Cross-linguistically, this kind of articulation is rare in typically-developing children’s speech, although it is observed in the speech of many children with a cleft palate. Linguolabial articulation was observed to be frequent in the speech of eight of the participants, AM.E (5;0), HD.M (5;0), AM.H (5;1), A.ML (5;4) M.A (5;6), M.H (6;1), M.R (7;3), R.N (9;4). T Table 7.2 shows linguolabial realisations in these participants.

Table 7.2 Inventory of linguolabial realisations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;0 | /d/→/d̼/ | /komod/ | [komod̼] | SFWF | ‘wardrobe’ |
| AM.H | 5;1 | /l/→/l̼/ | /ɡol/ | [ɡol̼] | SFWF | ‘flower’ |
| A.ML | 5;4 | /n/→/n̼/ | /ʔænɒro/ | [ʔæn̼ɒl̼o] | SIWW | ‘and pomegranate’ |
| M.A | 5;6 | /n/→/n̼/  /l/→/l̼/  /r/→/l̼/ | /niki/  /ʔænɒro/  /ɡol/  /mɒr/ | [n̼ihi]  [ʔæn̼ɒo]  [mol̼]  [mɒl̼] | SIWI  SIWW  SFWF  SFWF | ‘girls name’  ‘and pomegranate’  ‘flower’  ‘Snake’ |
| M.R | 7;3 | /n/ → /n̼/  /t/ → /t̼/  /l/ → /l̼/ | /nun/  /ketɒbet/  /livɒn/  /kelid/  /ɡol/ | [n̼uø]  [ʔet̼ɒmet̼]  [l̼ibɒn]  [cel̼id]  [Gol̼] | SIWI  SIWW  SFWF  SIWI  SIWW  SFWF | ‘ bread’  ‘your book’  ‘glass’  ‘key’  ‘flower |
| R.N | 9;4 | /n/→/n̼/  /s/→/s̼/ | /ʔænɒro/  /se/  /ʔæsæl/  /ʔærus/ | [ʔæn̼ɒro]  [s̼e]  [ʔæs̼æl]  [ʔærus̼] | SIWW  SIWI  SIWW  SFWF | ‘and pomegranate’  ‘three’  ‘honey’  ‘bride’ |

All the linguolabial realisations have been observed for alveolar targets /n, t, l, d, r, s/. Albery (1996) stated that when the tongue has little room to move to produce the alveolar consonants, it has a tendency to go further forward. As a result alveolar targets are produced forward in a dental or labial position. Furthermore, this type of articulation might be a consequence of a class III malocclusion which was noted in four of these eight participants. Six children realised alveolar nasal /n/ as a nasal linguolabial [n̼]. Five participants used linguolabial lateral approximant [l̼] instead of alveolar lateral approximant [l]. Alveolar plosives /t, d/ was realised as linguolabial plosives only once by M.R (7;3) and AM.E (5;0) respectively.

### 7.2.1.1.2 Dental articulation

Dental consonants do not have phonemic status in many languages, and are absent from Farsi. Dental articulation which is one of the cleft palate speech characteristics is divided in two categories in this study; interdental articulation/interdentalisation and dentalisation. The difference is explained below.

### 7.2.1.1.2.1 Interdental articulation/interdentalisation

It is observed in nine of the participants’ speech, HD.M (5;0), AM.H (5;1), M.A (5;6), MH.N (5;9), M.H (6;7), F.R (7;1), M.R (7;3), AS.R (7;8), M.G (9;9). All the interdental realisations are illustrated in table 7.3.

Table7.3 Patterns of interdental articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participants | Age | Pattern | Target | Realisation | word position in the sentences | Gloss |
| HD.M | 5;0 | /ʒ/→[n̪͆] | /mɒʒik/ | [mæn̪͆iø] | SIWW | ‘marker’ |
| AM.H | 5;1 | /f/→[t̪͆]  /n/→[n̪͆]  /z/→[z̪͆]  /z/→[z̪͆]  /z/→[z̪͆]  /ʃ/→[ʃ̪͆]  /ʒ/→[z̪͆]  /h/→[l̪͆] | /file/  /ʔænɒro/  /zæn/  /mipæze/  /ɡɒz/  /ʃæb/  /ʒɒle/  /ʔɒhu/ | [t̪͆ile]  [ʔæn̪͆ɒl̪o]  [z̪͆æn]  [mipæz̪͆e]  [ɡɒz̪͆]  [ʃ̪͆̃æø]  [z̪͆ɒl̼e]  [ʔɒl̪͆u] | SIWI  SIWI  SIWI  SIWW  SFWF  SIWI  SIWI  SIWW | ‘elephant’  ‘pomegranate and’  ‘lady’  ‘cooks’  ‘oven’  ‘night’  ‘girl’s name’  ‘deer’ |
| M.A | 5;4 | /l/→[l̪͆] | /kilido/ | [hil̪͆̃ido] | SIWW | ‘key and’ |
| MH.N | 5;9 | /ʒ/→[j̪͆̃] | /ʒɒkæte/ | [j̪͆ɒkæde] | SIWI | ‘Jacket of’ |
| M.H | 6;1 | /t/→[t̪͆]  /t/→[d̪͆]  /d/→[d̪͆] | /ketɒbet/  /ketɒbet/  /dære/ | [ket̪͆ɒbed̪͆̃]  [ket̪͆̃ɒbed̪͆̃]  [d̪͆̃ære] | SIWW  SFWF  SIWI | ‘your book’  ‘your book’  ‘door of’ |
| F.R | 7;1 | /n/→[n̪͆] | /ʔænɒro/ | [ʔn̪͆ɒʔo] | SIWW | ‘pomegranate’ |
| M.R | 7;3 | /t/→[t̪͆̃]  /k/→[t̪͆̃] | /tupo/  /pɒkæt/ | [t̪͆upo]  [pɒt̪͆æt̼] | SIWI  SIWW | ‘Ball and’  ‘envelope’ |
| AS.R | 7;8 | /d/→[t̪͆]  /z/→[ʃ̪͆]  /ʤ/→[d̪͆]  /ʤ/→[d̪͆] | /komod/  /mipæze/  /ʤibe/  /mæʤid/ | [komot̪͆]  [mipæʃ̪͆e]  [d̪͆ibe]  [mæd̪͆iø] | SFWF  SIWW  SIWI  SIWW | ‘Wardrobe’  ‘cooks’  ‘pocket of’  ‘boy’s name’ |
| M.G | 9;9 | /ʤ/→[ʤ̪͆̃]  /ʤ/→[ʤ̪͆̃]  /ʤ/→[ʧ̪͆̃] | /ʤibe/  /mæʤid/  /kæʤ/ | [ʤ̪͆̃ibe]  [mæʤ̪͆̃̃iø]  [cæʧ̪͆̃] | SIWI  SIWW  SFWF | ‘pocket of’  ‘boy’s name’  ‘slant’ |

Three children, M.R, M.H and AS.R, realised alveolar plosives such as /t, d/ as interdental plosives [t̪͆, d̪͆]. AM.H (5;1) used interdental articulation for labiodental /f/, alveolars /n, s, z/, post alveolars /ʃ, ʒ/ consistently. F.R (7;1) also produced interdentals instead of alveolars. It is notable that interdental articulation occurred mostly in alveolar plosive and alveolar fricative targets.

### 7.2.1.1.2.2 Dentalisation as a secondary articulation

There were some realisations of dentalisation speech sounds in three participants, AM.E (5;0), AM.H (5;1) and M.H (6;1). Although AM.E (5;0) produced alveolar consonants /n, d, l/ as dentalised alveolar consonants [n̪, d̪, l̪] consistently, AM.H (5;1) and M.H (6;1) realised post alveolar sound /ʃ/ and alveolar /l/ as dentalised alveolars /s̪, l̪/ respectively. Table 7.4 shows dentalisation in the speech of three participants.

Table 7.4 Words illustrating dentalisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Paticipant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;0 | /n/→[n̪]  /d/→[d̪]  /d/→[d̪]  /l/→[l̪]  /l/→[l̪] | /niki/  /dære/  /ʧɒdor/  /kilido/  /gol/ | [n̪iki]  [d̪æde]  [ʧɒd̪or]  [kil̪id̪o]  [gol̪] | SIWI  SIWI  SIWW  SIWW  SFWF | ‘girl’s name’  ‘door of’  ‘scarf’  ‘key and’  ‘flower’ |
| AM.H | 5;1 | /ʃ/→[ʃ̪] | /muʃ/ | [muʃ] | SFWF | ‘mouse’ |
| M.H | 6;1 | /l/→[l̪] | /kilido/ | [kil̪id̪o] | SIWW | ‘key and’ |

### 7.2.1.1.3 Lateral articulation/lateralisation

An articulation in which the airflow is directed around the sides of the tongue while the tongue closes the centre route is called lateral (Ladefoged & Maddieson, 1996).

### 7.2.1.1.3.1 Lateral articulation

Lateral articulation was recorded in the speech of three children. It was mostly perceived in the syllable initial word initial position. Three children used lateral articulation for different target consonants (Table 7.5).

Table 7.5 Patterns and words illustrating lateral articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| A.R | 5;3 | /j/→[ɮ] | /jɒs/ | [ɮɒҫ] | SIWI | ‘Girl’s name’ |
| R.E | 6;1 | /ʃ/→[ɬ̃]  /ʒ/→[ɮ]  /ʒ/→[ɮ]  /t/→[ɬ]  /p/→[ɬ] | /ʃæb/  /ʒɒle/  /mɒʒik/  /ketɒbet/  /sup/ | [ɬæm]  [ɮɒle]  [mɒɮik]  [ҫeɬɒve]  [ҫuɬ] | SIWI  SIWI  Single word  SIWW  SFWF | ‘night’  ‘girl’s name’  ‘Marker’  ‘Your book’  ‘Soup’ |
| As.R | 7;8 | /f/→[ɮ] | /file/ | [ɮile] | SIWI | ‘the elephant’ |

One child, A.R (5;3), realised the central palatal approximant /j/ as a lateral fricative [ɮ] while she used palatal articulation for most of the consonants in her speech. Therefore, it should be considered why she used a lateral fricative for a target palatal approximant when she used palatal approximants for many target consonants that she could not produce accurately. As it was seen in only one word position (SIWI) it could be because of assimilation to the fricative of the coda consonant. As.R (7;8) used a lateral fricative [ɮ] for a target labiodental fricative though on one occasion only. R.E (6;1) articulated all her post-alveolar fricatives as a lateral in SIWW in single word and SIWI in sentence repetition. Moreover, she replaced two plosive sounds /p, t/ with a lateral fricative [ɬ] in SFWF and SIWW respectively.

### 7.2.1.1.3.2 Lateralisation as a secondary articulation

Harding and Grunwell (1996) stated that lateralisation is one of the cleft speech characteristics that might take place in typical speech development. However, Albery and Grunwell (1993) indicated that this is a notable feature in cleft speech in comparison with normal speech development. They stated that lateralisation does not disappear spontaneously and even shows resistance to intervention. Nine children with a cleft palate showed lateralized realisations in their speech. Table 7.6 illustrates some participants who applied lateralisation in their speech.

Table 7.6 Patterns and words illustrating lateralisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | pattern | target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;1 | /s/→[sˡ] | /se/  /ʔæsæl/  /ʔærus/ | [sˡe]  [ʔæsˡæl]  [ʔær͉usˡ] | SIWI  SIWW  SFWF | ‘Three’  ‘Honey’  ‘Bride’ |
| D.M | 5;2 | /j/→[jˡ] | /jɒs/  /mijɒd/ | [jˡɒj]  [mijˡɒd] | SIWI  SIWW | ‘Girl’ name’  ‘will come’ |
| A.R | 5;3 | /v/→[vˡ]  /ʒ/→[ҫˡ]  /s/→[ҫˡ]  /t/→[ҫˡ] | /vɒnet/  /ʒɒle/  /mɒʒik/  /ʔæsæl/  /ketɒbet/ | [vˡɒneҫ]  [ҫˡɒlɮe]  [mɒҫˡik]  [ʔæҫˡæl]  [ceҫˡɒbeҫˡ] | SIWI  SIWI  ‘SIWW in  Single word’  SIWW  SIWW  SFWF | ‘Van’  ‘Girl’s name’  ‘Marker’  ‘Honey’  ‘Your book’ |
| MH.N | 5;9 | /s/→[ҫˡ]  /ʃ/→[ҫˡ]  /ʧ/→ [ҫˡ] | /ʔæsæl/  /muʃ/  /piʧ/ | [ʔæҫˡæj]  [muҫˡ]  [piҫˡ] | SIWW  SFWF  SFWF | ‘Honey’  ‘Mouse’  ‘Screw’ |
| M.N | 6;3 | /s/→[sˡ] | /se/  /ʔæsæl/  /ʔærus/ | [sˡe]  [ʔæsˡæl]  [ʔælusˡ] | SIWI  SIWW  SFWF | ‘Three’  ‘Honey’  ‘Bride’ |
| AS.R | 7;8 | /ʃ/→[ʃˡ] | /mɒʃin/ | [mɒʃˡi(n)] | SIWW | ‘Car’ |
| R.N | 9;4 | /ʃ/→[ʃˡ] | /muʃ/ | [muʃˡ] | SFWF | ‘Mouse’ |
| M.G | 9;9 | /n/→[nˡ] | /niki/ | [nˡiki] | SIWI | ‘Girl’s name’ |

The target /s/ was lateralised in the speech of four children: two children also realised target post-alveolar consonants with lateralisation and two of them only lateralised alveolar fricative /s/. Child A.R (5;3) realised labial, alveolar and post alveolar targets as lateralised consonants. Child MH.N (5;9) used lateralisation along with palatal articulation in producing /s, ʃ, ʧ/. It is clear that he shows lateralisation by producing lateralised palatal fricatives in most positions. AM.E (5;1) and M.N (6;3) replaced alveolar fricative /s/ with lateralised alveolar fricative /sˡ/ in all three positions of the syllable in sentence repetition. M.G (9;9) used lateralisation only once in production of /n/ in SIWI.

### 7.2.1.1.4 Palatal articulation/palatalisation

### 7.2.1.1.4.1 Palatal articulation

Palatal articulation was recorded in the speech of fifteen participants. Thus, it is a prevalent realisation which has been observed in cleft palate speech of Farsi-speaking children. Examples are given in Table 7.7. Both fricatives and affricates were realised as a palatal articulation by eight children (D.M (5;2), A.R (5;3), M.A (5;4), MH.N (5;9), M.H (6;1), R.E (6;1), M.R (7;3), AS.R (7;8), and K.SH (8;4)). Nine children realised alveolar and post-alveolar fricatives /s, z, ʃ, ʒ/ as a palatal fricative [ҫ] consistently, for example AM.E realised /ʃæb/ as [ҫæb]. It is notable that the palatal approximant /j/ has been observed instead of voiced alveolar and post-alveolar fricatives /z, ʒ/ in seven children’s production. For instance child MH.N produced [jɒkede] for /ʒɒkete/. Post alveolar affricate /ʧ/ was realised as palatal fricative [ҫ] by five children. (D.M, A.R, M.A, MH.N and R.E). Two children (M.R and K.SH) realised post-alveolar afficate /ʤ/ as a palatal nasal [ɲ]. Furthermore, alveolar tap /r/ was recorded as a palatal approximant [j] in four children’s speech (M.A, MH.N, R.E, and AS.R), while two children, MH.N and R.E, realised the alveolar lateral approximant /l/ as a palatal approximant [j]. Replacing /ɾ/ with [j] is common in speech of typically-developing children who speak Farsi (Borzooi, 2015). Therefore, the realisation seen in the speech of four children may be a persisting immaturity which appears as a typical developmental pattern. Palatal articulation of the uvular plosive /G/ was also observed in the speech of four children: HD.M, H.S, A.R and AS.R. Three of these children used a palatal plosive [Ɉ] instead of /G/.

Table 7.7 Examples of palatal articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;0 | /ʃ/→[ҫ]  /ʒ/→[j] | /ʃæb/  /mɒʃin/  /muʃ/  /ʒɒkete/ | [ҫæb]  [mɒҫin]  [muҫ]  [jɒjed̪e] | SIWI  SIWW  SFWF  SIWI | ‘Night’  ‘Car’  ‘Snake’  ‘Jacket of’ |
| H.S | 5;1 | /G/→[j] | /ʧɒGe/ | [ʃɒje] | SIWW | ‘Fat’ |
| MH.N | 5;9 | /l/→[j]  /s/→[ҫ]  /s/→[ҫˡ]  /z/→[ҫ]  /r/→[j]  /ʃ/→[ҫ]  /ʃ/→[ҫˡ]  /ʧ/→[ҫˡ]  / ʒ /→[j]  / ʒ /→[ҫ] | /livɒn/  /kelido/  /ɡol/  /se/  /ʔærus/  /ʔæsæl/  /zæn/  /mipæze/  /ɡɒz/  /ræfte/  /surɒx/  /mɒr/  /ʃæb/  /muʃ/  /mɒʃin/  /piʧ/  / ʒ ɒkete/  /mɒ ʒ ik/ | [jivɒn]  [kejido]  [ɡoj]  [ҫe]  [ʔæjuҫ]  [ʔæҫˡæj]  [ҫæjn]  [mipæҫe]  [ʔɒҫ]  [jæfte]  [ҫujɒx]  [mɒj]  [ҫæb]  [muҫ]  [mɒҫˡin]  [piҫˡ]  [jɒkede]  [mɒҫik] | SIWI  SIWW  SFWF  SIWI  SFWF  SIWW  SIWI  SIWW  SFWF  SIWI  SIWW  SFWF  SIWI  SFWF  SIWW  SFWF  SIWI  ‘SIWW in Single word’ | ‘Glass’  ‘Key and’  ‘Flower’  ‘Three’  ‘Bride’  ‘Honey’  ‘Lady’  ‘cooks’  ‘Oven’  ‘Has gone’  ‘Whole’  ‘Snake’  ‘Night’  ‘Mouse’  ‘Car’  ‘Screw’  ‘Jacket of’  ‘Marker’ |
| P.D | 5;9 | /k/→[c]  /ɡ/→[c] | /xuk/  /sæg/ | [xuc]  [ȿæc] | SFWF  SFWF | ‘Pig’  ‘Dog’ |
| M.R | 7;3 | / ʒ /→[ʝ]  /ʧ/→[c]  /ʤ/→[ɲ] | / ʒ ɒkete/  /ʃufɒƷ/  /ʧubo/  /bæʧ/  /ʤibe/  /mæʤid/ | [ʝɒtæte]  [hufɒʝ]  [cubo]  [bæce]  [ɲime]  [mæɲid̼] | SIWI  SFWF  SIWI  SIWW  SIWI  SFWF | ‘Jacket of’  ‘Heater’  ‘Wood and’  ‘Child’  ‘Pocket of’  ‘Boy’s name’ |
| N.F | 8;1 | /d/→[ɲ] | /dære/ | [ɲære] | SIWI | ‘Door of’ |

### 7.2.1.1.4.2 Palatalisation as a secondary articulation

Palatalisation was recorded in the speech of only one child with cleft palate, M.H (6;1). He produced post-alveolar affricate /ʧ/ as a palatalized one [ʧʲ] in SIWI and SIWW position.

Table 7.8 Patterns and words illustrating palatalisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| M.H | 6;1 | /ʧ/→[ ʧʲ] | /ʧubo/  /bæʧe/ | [ʧʲubo]  [bæ ʧʲe] | SIWI  SIWW | ‘wood and’  ‘Child’ |

### 7.2.1.1.5 Double articulation

As mentioned in chapter 4, double articulation has been categorised as an anterior or posterior CSC because, when alveolar plosive targets are perceived as [t͡k] or [d͡g], they could be grouped either with alveolars, in anterior oral CSCs, or with velars, in posterior oral CSCs (Sell *et al.,* 1999). Two children exhibited double articulation in their speech. This affected only plosive targets. M.N, used double articulation to produce plosive targets /t/ whereas MH.N (5;9) used this kind of articulation to produce the plosive targets /d/. This characteristic can be seen in Table 7.9.

Table 7.9 Patterns and words illustrating double articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| M.N | 6;3 | /t/→[p͡t] | /tupo/ | [p͡tupo] | SIWI | ‘Ball and’ |
| MH.N | 5;9 | /d/→ [d͡ɡ] | /komod/ | [komod͡ɡ] | SFWF | ‘Wardrobe’ |

7.2.1.2 Posterior oral cleft speech characteristics

Using backing articulation is common in the speech of participants with cleft palate and it is also observed in non-cleft speech disorders.

### 7.2.1.2.1 Backing to velar

This kind of realisation was observed in the speech of nine children in the study group. Four children produced voiced alveolar plosive /d/ as [ɡ] in SIWI an SIWW positions, while two other children realised voiceless alveolar plosive /t/ as a velar plosive [k]. Two children M.A (5;6) and R.N (9;4) used a velar approximant [ɰ] for a target alveolar tap in two different positions SIWW and SFWF respectively.

Table 7.10 Examples of backing to velar

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.M | 5;1 | /t/→[k] | /ketɒbet/ | [ʧekɒbe] | SIWW | ‘Your book’ |
| A.R | 5;3 | /d/→[ɡ] | /dære/  /ʧɒdor/ | [ɡæle]  [ҫɒɡo] | SIWI  SIWW | ‘Door of’  ‘Scarf’ |
| M.A | 5;6 | /r/→[ɰ] | /surɒx/ | [ҫuɰɒh] | SIWW | ‘Hole’ |
| R.E | 6;1 | /d/→[ɡ] | /ʧɒdor/ | [cɒɡo] | SIWW | ‘Scarf’ |
| M.N | 6;3 | /d/→[ɡ] | /dære/ | [ɡæle] | SIWI | ‘Door of’ |
| AS.R | 7;8 | /d/→[ɡ] | /dære/  /ʧɒdor/ | [ɡæɽe]  [ʧɒɡo] | SIWI  SIWW | ‘Door of’  ‘Scarf’ |
| R.N | 9;4 | /r/→[ɰ] | /mɒr/ | [mɒɰ] | SFWF | ‘Snake’ |

### 7.2.1.2.2 Backing to uvular

This type of articulation was very rare in the speech of the children with a cleft palate: only one child, AM.E (5;0) replaced velar fricative target /x/ with uvular plosive [G] in SFWF position.

Table 7.11 indicates pattern of backing to uvular

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;0 | /x/→[G] | /jæx/ | [jæG] | SFWF | ‘Ice’ |

### 7.2.1.3 Non-oral cleft speech characteristics

Non-oral cleft speech characteristicsinvolve places of articulation located below the level of the velopharyngeal valve

### 7.2.1.3.1 Pharyngeal articulation

Pharyngeal place of articulation is found for consonants in some languages, e.g. Arabic. In languages that lack pharyngeal consonants, individuals with cleft palate have been observed to pronounce target non-pharyngeal consonants as pharyngeal consonants. Pharyngeal articulation of fricatives was recorded in four children in the present study (Table 7.12). All four children substituted a voiceless pharyngeal fricative [ħ] for the target. The only one who used a voiced pharyngeal fricative [ʕ] was child H.S, for whom pharyngeal articulation was a pervasive pattern: fricative targets /f, x/ and plosives /k, ɡ/ were consistently realised as a pharyngeal fricative [ħ] in SIWI and SIWW positions. This is likely to have a profound impact on the child’s phonological system.

Table 7.12 Examples of pharyngeal articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| H.S | 5;1 | /f/→[ħ]  /x/→[ħ]  /k/→[ħ]  /ɡ/→[ħ]  /G/→[ʕ] | /file/  /sefid/  /xɒle/  /pɒkæt/  /sæɡ/  /Gɒz/ | [ħile]  [ħeħit]  [ħɒne]  [pɒħæt]  [ħæħ]  [ʕɒq] | SIWI  SIWW  SIWI  SIWW  SFWF  SIWI | ‘Elephant’  ‘White’  ‘Aunt’  ‘Envelope’  ‘Dog’  ‘Goose’ |
| M.A | 5;6 | /v/→[ħ] | /ɡɒv/ | [ɒħ] | SFWF | ‘Cow’ |
| M.R | 7;3 | /x/→[ħ] | /xɒle/ | [ħɒl̼e] | SIWI | ‘Aunt’ |
| AS.R | 7;8 | /z/→[ħ] | /zæn/ | [ħæn] | SIWI | ‘Lady’ |

### 7.2.1.3.2 Glottal articulation

Glottal realisation was noted in the speech of 15/21 children. Therefore, it is one of the most common characteristics. Three children, A.ML, F.R and M.R, used only glottal stop [Ɂ], and A.R, M.N and K.SH used only the glottal fricative [h], while the other nine children used both glottal stop and glottal fricative.

Table 7.13 illustrates the distribution of glottal realisations. Plosive and fricative targets were realised as glottal more than the other consonants. The plosive targets /p, d, t, k, ɡ/ were substituted by glottal consonants [h, Ɂ] in the speech of eleven children with a cleft palate, and fricatives /f, v, x, s, z, ʃ/ were articulated as a glottal by nine participants. Some of the children such as H.S and M.A used glottal articulation consistently in the different positions SIWI, SIWW, SFWF whereas others such as M.G and M.N applied glottal articulation in only one word position. Seven children (HD.M, H.S, D.M, M.A, R.E, F.R and M.R), consistently realised more than four different oral pressure targets as a glottal consonant, which had a major impact on their phonological systems.

Glottalisation as a secondary articulation was observed in the speech of only one child, M.R (7;3). He realised a target plosive /d/ as a glottalised plosive [dˀ] in only one position of the word, SIWW.

Table 7.13 Examples of glottal articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| H.S | 5;1 | /s/→[h]  /z/→[h]  /t/→[Ɂ]  /x/→[h] | /se/  /Ɂæsæl/  /zæn/  /ketæbet/  /jæx/ | [heh]  [Ɂæhæn]  [hæn]  [hepɒbeɁ]  [jæh] | SIWI  SIWW  SIWI  SFWF  SFWF | ‘three’  ‘honey’  ‘a lady’  ‘your book’  ‘ice’ |
| A.ML | 5;4 | /p/→[Ɂ] | /ʧupɒne/  /sup/ | [ɁuɁɒne]  [n̥͋uɁ] | SIWW  SFWF | ‘shepherd’  ‘soup’ |
| R.E | 6;1 | /ʤ/→[h]  /f/→[h]  /v/→/h/  /m/→[Ɂ] | /mæʤid/  /kif/  /ɡɒv]  /kæm/ | [mæhti]  [n̥͋ih]  [ɡɒh]  [cæɁ] | SIWW  SFWF  SFWF  SFWF | ‘boy’s name’  ‘bag’  ‘cow’  ‘a bit’ |
| M.R | 7;3 | /r/→[Ɂ]  /ɡ/→[Ɂ]  /ʤ/→[Ɂ]  /x/→[Ɂ] | /ræfte/  /ɡuʃe/  /sæɡ/  /kæʤ/  /jæx/ | [Ɂæfte]  [Ɂun̥͋e]  [n̥͋æɁ]  [cæɁ]  [jæɁ] | SIWI  SIWI  SFWF  SFWF  SFWF | ‘has gone’  ‘ear of’  ‘dog’  ‘curved’  ‘ice’ |
| K.SH | 8;4 | /x/→[h] | /xɒle/  /jæx/ | [hɒle]  [jæh] | SIWI  SFWF | ‘aunt’  ‘ice’ |

Table 7.14 Pattern and word illustrating glottalisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| M.R | 7;3 | /d/→[dˀ] | /ʧɒdor/ | [ʧɒdˀo] | SIWW | ‘Scarf’ |

### 7.2.1.3.3 Active nasal fricatives

As described in chapter 4, perceptually distinguishing between passive nasal realisation of fricatives and active nasal fricatives might be difficult (Sell *et al,* 1999). Where a nasal fricative was transcribed it was not possible to determine whether it was an active nasal fricative or a passive nasal fricative. Harding & Grunwell (1998) recommend nose holding in the live assessment but this could not be done in the present study. Instead, the distinction between active or passive is tentatively based on whether the speech sample for the child in question contains additional signs of velopharyngeal dysfunction (VPD). Where a speech sample contains realisations of voiceless consonants such as [p, t, k] without audible nasal emission, and nasal resonance is normal, nasal fricative realisations are assumed to be active.

Table 7.15 shows all the active nasal fricative realisations found in the data. Six children with cleft palate used nasal fricative realisations in their speech. Target voiceless alveolar fricative /s/ was realised as active alveolar nasal fricative [n̥͋] by all six children. Two children, K.SH and M.G, substituted [n̥͋] for target /s/ in all word positions, SIWI, SIWW and SFWF, while two children used [n̥͋] for /s/ in only one position. The most common word position for using active nasal fricative was SFWF position.

Contrary to Sell et al’s (1999) assertion that only fricative targets are realised as the active nasal fricatives, two children, H.S and M.A, produced active nasal fricatives [m̥͋, n̥͋] for the plosive /t/, in SIWW position. These two children are the youngest participants. As both the participants produced nasal fricatives for the same target, /ketɒbet/, it might be because of the phonetic context of the /t/ in the particular word: since production of medial /t/ does have a fricative component during the onset and the transition into vowel, it might be misperception of the SIWW /t/. M.R used alveolar nasal fricative [n̥͋] for both alveolar and post-alveolar fricatives /s, ʃ/.

Table 7.15 Active nasal fricative realisations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| HD.M | 5;0 | /s/→[n̥͋]  /f/→[m̥͋]  /ʃ/→[m̥͋]  /ʒ/→[(n̥͋)] | /Ɂæsæl/  /Ɂærus/  /kif/  /muʃ/  /ʃufɒʒ/ | [Ɂæn̥͋æm]  [hæɁun̥͋]  [him̥͋]  [mum̥͋]  [m̥͋uhɒ(n̥͋)] | SIWW  SFWF  SFWF  SFWF  SFWF | Honey  Bride  Bag  Mouse  Heater |
| H.S | 5;1 | /t/→[m̥͋] | /ketɒbet/ | [hem̥͋ɒbeɁ] | SIWW | Your book |
| M.R | 7;3 | /ʃ/→[n̥͋]  /s/→[n̥͋] | /ʃæb/  /mɒʃin/  /muʃ/  /Ɂæsæl/  /Ɂærus/ | [n̥͋æb]  [mɒn̥͋in]  [mun̥͋]  [Ɂæn̥͋æl]  [ɁæɁun̥͋] | SIWI  SIWW  SFWF  SIWW  SFWF | At night  Car  Mouse  Honey  Bride |
| N.F | 8;1 | /s/→[n̥͋] | /Ɂærus/ | [Ɂærun̥͋] | SFWF | Bride |
| K.SH | 8;4 | /t/→[n̥͋]  /s/→[n̥͋] | /tupo/  /se/  /Ɂæsæl/  /Ɂærus/ | [n̥͋upo]  [n̥͋e]  [Ɂæn̥͋æl]  [Ɂærun̥͋] | SIWI  SIWI  SIWW  SFWF | Ball and  Three  Honey  Bride |
| M.G | 9;9 | /s/→[n̥͋] | /se/  /Ɂæsæl/  /Ɂærus/ | [n̥͋e]  [Ɂæn̥͋æl]  [Ɂærun̥͋] | SIWI  SIWW  SFWF | Three  Honey  Bride |

### 7.2.1.4 Passive cleft-type speech characteristics

Based on GOS.SP.ASS’98, these CSCs are categorised as weak/nasalised articulation, nasal realisation of fricative, nasal realisation of plosive, absent pressure consonants and gliding of fricatives/affricates.

### 7.2.1.4.1 Weak and/or nasalised articulation

Weak articulation in word final position is common in typical Farsi speech, especially when the target is utterance final as well as word final. Therefore, weak articulation at the end of an utterance in these data was considered as a normal feature. Although weak articulation was noted to some extent in the speech of all participants with cleft palate, for some children it was found with target oral pressure consonants. Examples of this realisation are shown in table 7.16.

Table 7.16 illustrates some examples of weak and / or nasalized realisations of oral pressure consonants.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| A.ML | 5;4 | /p/→[b͉̃]  /z/→[z͉̃] | /pir/  /zæn/  /mipæze/ | [b͉̃i]  [z͉̃æn]  [mipæz͉̃e] | SIWI  SIWI  SIWW | Old  Woman  Is cooking |
| MH.N | 5;9 | /d/→[d͉̃] | /dære/ | [d͉̃æje] | SIWI | Door of |
| P.D | 5;9 | /d/→[d͉̃]  /ʃ/→[ʃ͉̃] | /dære/  /muʃ/ | [d͉̃ære]  [muʃ͉̃] | SIWI  SFWF | Door of  Mouse |
| M.G | 9;0 | /z/→[z͉̃] | /mipæze/ | [mipæz͉̃e] | SIWW | Is cooking |

### 7.2.1.4.2 Passive nasal realisation of fricatives

Based on transcription of nasal realisations, nasal emission accompanying other consonant and /or weak articulation passive nasal realisation of fricatives was identified in the speech of nine cleft palate participants. As explained above, in this study the categorisation of a realisation as passive is based on the presence in the complete speech sample for the child in question of additional signs of velopharyngeal dysfunction (VPD). The oral fricatives that were replaced with nasal sounds were /z, v, s, ʒ/. On most occasions the targets were the voiced fricatives, for instance five children realised a voiced labial fricative /v/ as a weak voiceless bilabial nasal in different positions of a syllable, whereas only one child used a passive nasal realisation for a target voiceless sound, the alveolar fricative /s/, which D.M. realised as a palatal nasal [ɲ] (see Table 7.17).

Table 7.17 Replacements of nasal consonants for fricative targets.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| HD.M | 5;0 | /z/→[m̥͋]  /z/→[(s)n̥͋]  /ʒ/→[n̥͋]  /ʒ/→[n̪̥͆͋]  /v/→[(f)m̥͋] | /zæn/  /mipæze/  /ʒɒkæte/  /mɒʒik/  /Ɂɒvordæn/ | [m̥͋æm]  [minæ(s)n̥͋e]  [n̥͋ɒnæne]  [mɒn̪̥͆͋i]  [Ɂɒ(f)m̥͋onæn] | SIWI  SIWW  ‘SIWI in single word’  ‘SIWW in  single word’  SIWW | Woman  Is cooking  Jacket of  Marker  Brought |
| H.S | 5;1 | /v/→[(f)m̥͋]  /ʒ/→[n̥͋] | /vɒnet/  /Ɂɒvordæn/  /ʒɒkæte/ | [(f)m̥͋ɒneħ]  [Ɂɒ(f)m̥͋onæn]  [n̥͋ɒhæhe] | SIWI  SIWW  SIWI | Van  Brought  Jacket of |
| D.M | 5;2 | /s/→[(s)ɲ̥͋]  /v/→[(f)m̥͋] | /se/  /vɒnet/ | [(s)ɲ̥͋e]  [(f)m̥͋ɒnet] | SIWI  SIWI | Three  Van |
| M.R | 7;3 | /z/→[(s)n̥͋] | /mipæze/ | [mipæ(s)n̥͋e] | SIWW | Is cooking |

### 7.2.1.4.3 Nasal realisation of plosives

This type of realisation was identified in the speech of 11 children. As shown in table 7.18, it is clear that all the high-pressure plosives, which include /b, d, t, k, ɡ/, were realised as nasals such as [m, n, ɲ]. For some children such as H.S (5;1) who substituted [n] for /d/ in all positions, this was a systematic pattern.

Table 7.18 Examples of nasal realisation of plosives

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| H.S | 5;1 | /b/→[m]  /d/→[n] | /bæd/  /dære/  /ʧɒdor/  /komod/ | [mæɁ]  [næne]  [ʃɒnon]  [tomon] | SIWI  SIWI  SIWW  SFWF | Bad  Door of  Scarf  Wardrobe |
| D.M | 5;2 | /d/→[ɲ]  /ɡ/→[ɲ] | /dære/  /mæɡæs/ | [ɲæhe]  [mæɲæh] | SIWI  SIWW | Door of  Fly |

### 7.2.1.4.4 Gliding of fricatives/affricates

All gliding realisations of fricatives and affricates are shown in table 7.19. Eight children used [j] to realise the three fricatives /v, z, ʒ/ and one of the two target affricates, /ʤ/. Five of them replaced /ʒ/ with [j] in SIWI in the word /ʒɒkete/. This might have resulted from misperception and/or weak articulation because the target /ʒ/ and the realisation [j] share the features of voice and continuance (fricative and approximant) as well as adjacent places of articulation (post-alveolar and palatal). M.H (6;1) consistently realised the alveolar fricative /z/ as a palatal approximant in all three positions: SIWI, SIWW and SFWF. The fact that he misarticulated most fricatives, /f, v, s, z, ʃ/, suggests that there might be some difficulties in his auditory perception.

Table 7.19 Patterns and words illustrating gliding realisation of fricatives/affricates.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;0 | /ʒ/→[j] | /ʒɒkete/ | [jɒjede] | SIWI | Jacket of |
| D.M | 5;2 | /z/→[j]  /v/→[j] | /zæn/  /ɡɒz/  /ɡɒv/ | [jæn]  [bɒj]  [dɒj] | SIWI  SFWF  SFWF | Woman  Oven  Cow |
| MH.N | 5;9 | /ʒ/→[j] | /ʒɒkete/ | [jɒkede] | SIWI | Jacket of |
| M.H | 6;1 | /z/→[j]  /ʒ/→[j] | /zæn/  /mipæze/  /ɡɒz/  /ʒɒkete/ | [jæn]  [mipæje]  [ɡɒj]  [jɒjece] | SIWI  SIWW  SFWF  SIWI | Woman  Is cooking  Oven  Jacket of |
| R.E | 6;1 | /ʤ/→[j] | /ʤibe/ | [jibe] | SIWI | Pocket of |
| F.R | 7;1 | /z/→[j] | /zæn/ | [jæn] | SIWI | Woman |
| AS.R | 7;8 | /ʒ/→[j] | /ʒɒket/ | [jɒce] | ‘SIWI in single word’ | Jacket |
| K.SH | 8;4 | /ʒ/→[j] | /ʒɒkete/  /ʃufɒʒ/ | [jɒkete]  [lufɒj] | SIWI  SFWF | Jacket of  Heater |

### 7.2.1.5 Non-cleft developmental realisations

This category consists of those productions normally identified in the speech of typically-developing children. As mentioned in chapter 6, those productions, which are observed in the speech of typically-developing children, are predictable at an appropriate age.

Harding and Grunwell (1998) included non-cleft developmental realisations in the classification of cleft-type speech characteristics because a child with cleft palate may also have a non-cleft phonological disorder which is characterised by atypical simplification processes that are independent of but co-exist with speech problems arising from cleft palate.

Non-cleft developmental processes including final consonant deletion, stopping and fronting were identified in the speech of 20 of the children with cleft palate in the present study. Some of these patterns, such as fronting, are categorised as persisting immaturities, because they are not age-appropriate realisations for these children, whereas others, such as lateral realisation of tap, are typical for the age of these children, according to the Farsi phonetics and phonology literature (Fahim, 1996). Tables 7.20 and 7.21 illustrate non-cleft developmental realisations in the speech of some of the children with cleft palate.

Table 7.20 Examples of structural non-cleft developmental processes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Process | Participant | Age | Pattern | Target | Realisation | Gloss |
| Final consonant deletion | H.S | 5;1 | /r/→[Ø] | /mɒr/ | [mɒ] | Snake |
| D.M | 5;2 | /t/→[Ø] | /ketɒbet/ | [hetɒbe] | Your book |
| A.ML | 5;4 | /d/→[Ø] | /komod/ | [komo] | Wardrobe |

Table 7.21 Examples of systemic non-cleft developmental processes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Process | Participant | Age | Pattern | Target | Realisation | Gloss |
| Fronting | H.S | 5;1 | /k/→[t] | /kife/  /xuk/ | [tiħe]  [put] | Bag of  Pig |
| Stopping | MH.N  N.F  D.M | 5;9  8;1  5;2 | /ʤ/→[ɡ]  /z/→[d]  /f/→[p] | /ʤibe/  /ɡɒz/  /file/ | [ɡibe]  [ɡɒd]  [pine] | Pocket of  Oven  Elephant |

Three different non-cleft developmental realisations were observed in the speech of two participants with cleft palate A.ML (5;4) and AS.R (7;8). A.ML used final consonant deletion, stopping and fronting in his speech while AS.R applied final consonant deletion, substitution of [l] for /ɾ/ and stopping in her speech. Stopping was used in the speech of six children in the range of 5;0 to 8;1 year-old participants. It could be the case that these participants with cleft palate show signs of non-cleft speech delay.

Ten of the children with cleft palate produced [l] for target /ɾ/. Lateral realisation of a tap or substitution of /ɾ/ is a common realisation in the speech production of typically-developing children up to 6 years of age who speak Farsi (Fahim, 1996; Borzooi, 2016). Therefore, as mentioned in chapter 6, it was expected that this non-cleft developmental articulation would be found in the speech of Farsi-speaking children with cleft palate. Some examples are shown in table 7.22.

Table 7.22 Examples of lateral realisation of a tap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| AM.E | 5;0 | /ɾ/→[l] | /suɾæx/ | [sulæx] | SIWW | ‘hole’ |
| AM.H | 5;1 | /ɾ/→[l] | /suɾæx/ | [ҫulɒx] | SIWW | ‘hole’ |
| A.R | 5;3 | /ɾ/→[l] | /ɾæfte/ | [læce] | SIWI | ‘has gone’ |
| M.A | 5;6 | /ɾ/→[l] | /mɒɾ/ | [mɒl̼] | SFWF | ‘Snake’ |

### 7.2.1.6 Farsi-specific cleft speech characteristics

As has been mentioned, some realisations were found that have not previously been categorised as cleft palate speech characteristics but were thought to be related to the cleft palate in these children. They included dentolabial articulation and retroflex articulation.

### 7.2.1.6.1 Dentolabial articulation

Dentolabial articulation was observed in one child from the cleft palate group when he was producing /f/. This type of dentalisation takes place when the lower teeth are placed against the upper lip. Cross-linguistically it seems to be rare but it can occur as a misarticulation due to a class III malocclusion. Examples are shown in table 7.23.

Table 7.23 Examples of dentolabial realisation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| M.N | 6;3 | /f/→[f͆͋]  /f/→[f͆͋]  /f/→[f͆͋] | /file/  /sefid/  /kif/ | [f͆͋ine]  [sˡef͆͋iø]  [kif͆͋͋] | SIWI  SIWW  SFWF | ‘the elephant’  ‘white’  ‘bag’ |

### 7.2.1.6.2 Retroflex articulation

Retroflex articulation is when the tip of the tongue has a curled shape and the place of articulation is between the alveolar ridge and the hard palate (Ladefoged & Maddieson, 1996). There are no retroflex consonants in the Farsi phonemic system. Although this type of articulation is not in the GOS.SP.ASS category of cleft speech characteristics, it was observed in the speech of four children in the present study (Table 7.24). The first child who shows this type of articulation in his speech is P.D. He consistently used [ɭ, ʂ, ʐ] for target /l, s, z/ in all positions. Another child, M.G, used retroflex plosive sounds for the target alveolar plosives. M.A and AS.R used retroflex articulation only for /s/ and /r/ respectively. These findings indicate that retroflex realisations should be included in the Farsi version of GOS.SP.ASS.

Table 7.24 Examples of retroflex articulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Age | Pattern | Target | Realisation | Word position in the sentences | Gloss |
| M.A | 5;6 | /s/→[ɽ] | /se/ | [ɽe] | SIWI | ‘Three’ |
| P.D | 5;9 | /l/→[ɭ]  /s/→[ʂ]  /z/→[ʐ] | /livɒn/  /kelid/  /ɡol/  /se/  /ʔæsæl/  /ʔærus/  /zæn/  /mipæze/  /ɡɒz/ | [ɭivɒn]  [ceɭiɖo]  [ɡoɭ]  [ʂe]  [ʔæʂæɭ]  [ʔæɽuʂ]  [ʐæn]  [mipæʐe]  [ɡɒʐ] | SIWI  SIWW  SFWF  SIWI  SIWW  SFWF  SIWI  SIWW  SFWF | ‘Glass’  ‘Key and’  ‘Flower’  ‘Three’  ‘Honey’  ‘Bride’  ‘Lady’  ‘cooks’  ‘Oven’ |
| AS.R | 7;8 | /r/→ [ɽ] | /mɒr/ | [mɒɽ] | SFWF | ‘Snake’ |
| M.G | 9;9 | /d/→[ɖ]  /t/→[ʈ] | /dære/  /ʧɒdor/  /komod/  /ketɒbet/  /ketɒbet/ | [ɖæɽe]  [ʧɒɖoɽ]  [komoɖ]  [keʈɒbeʈ]  [keʈɒbeʈ] | SIWI  SIWW  SFWF  SIWW  SFWF | ‘Door of’  ‘Scarf’  ‘Wardrobe’  ‘Your book’  ‘Your book’ |

## 7.3 Vowels

Hypernasality was observed as the main atypical features in the production of vowels. Many vowels were categorised as nasalized, using the Farsi GOS.SP.ASS convention for rating the severity of resonance. Another atypical production of vowel was applied only in the speech of one of the children with cleft palate, MH.N (5;9), who substituted [ʊ] for /o/ in word /holu/ ‘peach’. As mentioned in chapter 6, this type of substitution was observed in the speech of one typically-developing child in this word. It could be an instance of vowel harmony because in this word the vowel is followed by the back close vowel /u/.

## 7.4 Resonance and airflow

When the VP sphincter remains partially open during speech an abnormal balance of oral to nasal resonance results in a hypernasal tone, as perceived in the speech of some individuals with cleft palate. Hyponasality refers to decreased nasal resonance during production of sounds which should be fully nasal (Henningson *et al.,* 2008). Hyponasality is perceived when the nasal airway is partially closed (Peterson-Falzone *et al.,* 2001). Co-occurrence of hypernasality and hyponasality is called mixed nasality, (Mc Williams *et al.,* 1990; Sell *et al.,* 1999) while cul de sac refers to the resonance that is perceived as ‘’muffled’’ speech quality because of blocking in the pharyngeal or nasal cavity (Peterson-Falzone *et al.,* 2001).

### 7.4.1 Hypernasality and hyponasality

Using GOS.SP.ASS’98 (Sell *et al.,* 1999) categories, grades 1, 2 and 3 for hypernasality were perceived in the speech of six children in the cleft palate group, as shown in Table 7.24. Three speech samples, from M.R, H.S and K.SH, were rated as severely hypernasal consistently (grade 3). Mild hypernasality was observed affecting high vowels only (grade 1) in the speech of one participant D.M (5;2). Moderate hypernasality was heard consistently in a range of vowels and approximants (grade 2) in the speech samples from F.R and R.N.

Three speech samples were rated as hyponasal when using the GOS.SP.ASS’98 scale. Hyponasality was Mild on Nasal consonants was perceived slightly denasal in all these three children’s speech. Samples AM.E (5;0), A.ML (5;4) and M.A (5;6), were rated as consistently hyponasal. Moreover, mixed resonance was observed in the speech of two children N.F (8;10) and HD.M (5;0). Table 7.25 indicates the number of children and the different types of resonance that they used in their speech.

Table 7.25 Number of children who show different types of nasal resonance

|  |  |  |  |
| --- | --- | --- | --- |
|  | Hypernasality | Hyponasality | Mixed res. |
| Consistency and severity | Grade 1 Grade 2 Grade 3 | Grade 1 Grade 2 |  |
| Consistent  Inconsistent | 1 2 3  0 0 0 | 3 0  0 0 | 2 |

### 7.4.2 Audible nasal emission and turbulence

As in GOS.SP.ASS’98 (Sell *et al.,* 1999), where audible nasal emission and nasal turbulence were scored on 3-point scales, this research also used a three-point scale. Audible nasal emission commonly accompanying pressure consonant production and most readily perceived on voiceless pressure consonants was demonstrated by nine children. Only one participant, M.N, showed nasal emission in his speech consistently. Nasal turbulence was perceived in the speech of two children with a cleft palate, A.ML and M.N. It is notable that one of these children, M.N, showed nasal turbulence in her speech as well as severe nasal emission. Table 7.26 shows the number of children who demonstrated different levels of nasal emission and nasal turbulence.

Table 7.26 Number of participants demonstrating different level of nasal emission and nasal turbulence

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Normal | Audible nasal emission | Normal | Nasal turbulence |
| Consistency and severity |  | Grade 1 Grade 2 |  | Grade 1 Grade 2 |
| Consistent  Inconsistent  Accompanying/replacing | 12 | 0 1  6 2  0 0 | 19 | 0 1  1 0  0 0 |

## 7.5 Grimace

Five children with a cleft palate presented different levels of grimace, e.g. nasal flare was present in M.G and M.A whereas movement in the muscles of the mid and upper face was observed in three children, D.M, K.SH and H.S consistently.

Table 7.27 Number of children demonstrating different level of grimace

|  |  |
| --- | --- |
|  | Grimace |
| Consistency and severity | Grade 0 Grade 1 Grade 2 Grade 3 |
| Consistent  Inconsistent | 16 1 0 3  1 0 0 |

## 7.6 Voice quality

Voice disorder refers to deviation in voice features because of the structural and/or functional problem at the level of the larynx (Henningsson *et al.,* 2008). There was no significant atypical voice quality in the speech of participants with the cleft palate except for a mild creaky voice perceived in some parts of speech of one child, MH.N.

## 7.7 Summary

In this part, the research questions listed at the beginning of this chapter are considered in light of the results

Research Question 1 What are the types of cleft speech characteristics in children with a cleft palate? With regard to the types of cleft speech characteristics produced by Farsi-speaking children:

* 1. Are oral and non-oral cleft speech characteristics found in their speech?
  2. Are passive cleft speech characteristics found in their speech?
  3. Are non-cleft developmental speech patterns found in their speech?
  4. Are atypical realisations (i.e. realisations that are neither typical of normal development nor of cleft speech) found in their speech?
  5. Is their speech affected in terms of resonance, airflow and voice?

Research Question 1: What are the types of cleft speech characteristics in children with a cleft palate who speak Farsi?

For the first question of this study concerned with cleft speech characteristics for Farsi-speaking children, all of the cleft speech features listed and reported in the GOS.SP.ASS have been identified among the participants.

Research Question 1.a: Are oral and non-oral cleft speech characteristics found in their speech?

Research Question 1.b: Are passive cleft speech characteristics found in their speech?

All the U.K. GOS.SP.ASS oral, non-oral and passive cleft speech characteristics were observed in the speech of participants.

Research Question 1.c: Are non-cleft developmental speech patterns found in their speech?

Non-cleft developmental realisations were identified in the speech of children with cleft palate. There is evidence for the occurrence of systemic and structural developmental realisations affecting children with cleft palate, including final consonant deletion, fronting and stopping.

Research Question 1.d: Are atypical realisations (i.e. realisations that are neither typical of normal development nor of cleft speech) found in their speech?

An additional speech behavior has been suggested to be included as a cleft speech characteristic: retroflex. In comparison with the original GOS.SP.ASS the data showed additional features including linguolabial articulation and dental articulation.

Research Question 1.e: Is their speech affected in terms of resonance, airflow and voice?

The perceptual analysis indicated perception of hyper and hypo nasality and nasal airflow errors in the speech sample of some Farsi-speaking children with a cleft palate.

# Chapter 8 Cleft speech characteristics in Farsi: frequency, individual differences and contributory factors

## 8.1 Introduction

The speech production of 21 Farsi-speaking children aged 5 to 9;11, and born with a cleft palate, has been described in Chapter 7 in terms of cleft and non-cleft speech characteristics. The primary aim of this chapter is to explore factors that may influence the occurrence of those characteristics, such as differences in target sounds as well as differences among the children. The latter include differences in type of cleft palate and age at the time of assessment, as well as unspecified individual differences. As previously mentioned, to address the primary aims speech data has been analysed and presented based on examining the occurrence of individual speech characteristics from Farsi GOS.SP.ASS.

The research questions addressed in this chapter are questions 4, 5, 6, and 7:

Research question 5: What is the relative frequency of occurrence of different cleft speech characteristics in the speech of Farsi-speaking children with cleft palate?

Research Question 6: How are different target consonants affected in the speech of Farsi-speaking children with cleft palate?

Research Question 7: Is the occurrence of cleft speech characteristic related to the child’s age at assessment?

Research Question 8: Is the occurrence of cleft and non-cleft speech characteristic related to the type of cleft that the child has?

## 8.2 The relative frequency of occurrence of different cleft speech characteristics

The number and percentage of children with a cleft palate who exhibit different types of cleft speech characteristics, are indicated in the tables below. Children were included if they only demonstrated one occurrence of the cleft speech characteristics.

Table 8.1 demonstrates that passive CSCs, along with non-cleft realisations, were produced by almost all the participants. In terms of oral cleft speech characteristics, as it is presented in table 8.1, anterior CSCs were seen in the speech of 20 children (95%) and 10 children (48%) used posterior CSCs in their speech. Therefore, both anterior and posterior oral cleft speech characteristics occurred frequently in the speech of Farsi-speaking children with a cleft palate. The children who show these characteristics are likely to have problems in communicating and so need speech therapy.

Table 8.1 Percentages of the main categories in CSCs

|  |  |  |  |
| --- | --- | --- | --- |
| Cleft speech characteristics | Numbers of children | Percentage | |
| Anterior Oral CSCs | 20 | 95% |  |
| Posterior Oral CSCs | 10 | 48% |  |
| Non-oral CSCs | 16 | 76% | |
| Passive CSCs | 20 | 95% | |
| Non-cleft developmental realisations | 20 | 95% | |

### 8.2.1 Relative frequency of anterior and posterior oral CSCs

The numbers of children presenting with the various different oral CSCs are set out in Table 8.2.

Table 8.2 Number and percentage of participants who used different types of oral CSCs

|  |  |  |
| --- | --- | --- |
| Oral CSCs | Number of children | Percentage |
| Anterior CSCs | 20 | 95% |
| Linguolabial articulation | 8 | 39% |
| Dental articulation/Dentalisation | 12 | 57% |
| Lateral articulation/Lateralisation | 10 | 48% |
| Palatal articulation/Palatalisation | 15 | 71% |
| Double articulation | 2 | 10% |
| Posterior CSCs | 10 | 48% |
| Double articulation | 0 | 0% |
| Backing to velar | 9 | 43% |
| Backing to uvular | 1 | 5% |

According to GOS.SP.ASS’98, double articulation could be observed in the anterior and/or posterior oral cavity. This articulation was not seen as a posterior oral CSC in the speech of Farsi-speaking children with a cleft palate. In addition, backing to uvular was observed in the speech of only one child, AM.E (5;0). It should be noted that palatal realisations were observed in the speech of 15 participants with a cleft palate (71%). Therefore, most participants used it in their speech, whereas double articulation was either rarer (anterior) or non-existent (posterior). These results indicate that there is considerable variability in the occurrence of the different oral CSC’s.

### 8.2.2 Relative frequency of non-oral CSCs

The same observation can be made about non-oral CSC’s (Table 8.3) Glottal articulation was produced by a majority of children, whereas pharyngeal and active nasal fricative realisations were made by a quite small minority.

Table 8.3 Number and percentage of participants who used non-oral CSCs

|  |  |  |
| --- | --- | --- |
| Non-oral CSCs | Number of children | Percentage |
| Pharyngeal articulation | 4 | 19% |
| Glottal articulation | 15 | 71% |
| Active nasal fricative | 7 | 33% |

### 8.2.3 Relative frequency of passive CSCs

It was seen in Table 8.1 that almost all children used passive CSCs in their speech However, there was considerable variation in the occurrence of the different passive CSCs, as shown in Table 8.4. The most severe CSC, ‘Absent pressure consonants’, was only observed in one child, whereas the phonetic variant of weak nasalised articulation was observed in the majority of participants.

Table 8.4 Number and percentage of participants who used passive CSCs

|  |  |  |
| --- | --- | --- |
| Passive CSCS | Number of children | Percentage |
| Weak and/or nasalised articulation | 15 | 71% |
| Nasal realisation of plosives | 11 | 52% |
| Nasal realisation of fricatives | 9 | 43% |
| Absent pressure consonants | 1 | 4% |
| Gliding of fricatives/affricates | 8 | 39% |

Table 8.5 focuses on the realisation of nasal fricative as an active or passive CSC. It is interesting that nasal fricatives appeared to be realised as both active and passive in the speech of 60% of children who realised nasal fricatives in their speech. However, a definitive diagnosis of active versus passive realisations from this data would require more detailed assessment. Harding & Grunwell (1998) stated that different diagnoses between passive and active nasal fricatives can result in different surgical or therapeutic interventions. As active and passive nasal fricatives were observed in the speech of almost half of the children with a cleft palate in this study, they may need both surgical and therapeutic management. However, it should be recalled that the categorisation of nasal fricatives or active or passive was based on speech analysis only and the clinical diagnosis of active versus passive requires more detailed assessment.

Table 8.5 Number and percentage of children who used nasal fricatives

|  |  |  |
| --- | --- | --- |
| Nasal fricatives | Number of children | Percentage of the entire group |
| Only active nasal fricatives | 1 | 4% |
| Only passive nasal realisation of fricatives | 3 | 14% |
| Mixed Active nasal fricatives and passive nasal realisation of fricatives | 6 | 28% |
| Total | 10 | 48% |

### 8.2.4 Relative frequency of non-cleft developmental realisations and additional cleft realisations

Non-cleft developmental realisations were shown in the speech of 20 children with a cleft palate (Table 8.6). Furthermore, additional cleft articulation which was retroflex articulation was realised in the speech of five children with a cleft palate (Table 8.7).

Table 8.6 Number and percentage of participants who used non-cleft realisations

|  |  |  |
| --- | --- | --- |
|  | Number of children | Percentage |
| Non-cleft developmental realisations | 20 | 95% |
| Fronting | 6 | 29% |
| Stopping | 15 | 71% |
| Final consonant deletion | 7 | 33% |
| Lateral realisation of a tap | 10 | 48% |

Table 8.7 Number and percentage of participants who used additional cleft realisations

|  |  |  |
| --- | --- | --- |
| Additional cleft realisation | Number of children | Percentage |
| Retroflex articulation | 5 | 24% |

### 8.2.5 Summary

The results in this section show that Farsi-speaking children with a cleft palate use almost all the hypothesised cleft speech characteristics, most of which are similar to those reported in the speech of English-speaking children with a cleft palate. In common with most studies, this study found that glottal articulation is the most common compensatory articulation used in the speech of children with a cleft palate (Grunwell *et al.,* 1993; Harding & Grunwell, 1996; Peterson-Falzone *et al.,* 2006). Palatal articulation as well as glottal articulation was observed in the speech of most Farsi-speaking children. Palatal articulation was seen in the realisation of target alveolar and post-alveolar consonants such as /s, z, ʃ, ʧ, ʤ/ in this study. It appears that the children with a cleft palate adopt the strategy to optimize their control of the oral airflow by raising the back of their tongue and as a result tend to produce alveolar and post-alveolar target consonants in the palatal place or velar consonants in the glottal place.

Another cleft speech characteristic observed in the speech of most children is weak nasalised pressure consonants. According to GOS.SP.ASS classification, a passive cleft speech characteristic is commonly observed in the speech of individuals with a cleft palate regardless of their language. It occurs as a result of the pressure leak at the velopharyngeal port and a lowering of the intra-oral pressure (Trost, 1981).

Hardin-Jones (2005) found that a substitution of nasal consonants occurred in the speech of a large number of children with a cleft palate which could have resulted from VPD in some cases or it is a learned behaviour in the speech of children without velopharyngeal dysfunction.

Backing to uvular as an oral CSC was seen in the speech of only one child in this study. Production of [G] in the speech of AM.E might be due to hearing problem in past or present. Furthermore, absent pressure consonant as a passive CSC was observed in one child in this study. The range of consonants which were produced by this child was not limited to only nasal consonants. Moreover, the production of pressure consonants was observed in the speech of all the other children. Occurrence of this characteristic strongly indicates VPI (Sell & Ma, 1996).

## 8.3 Differences between participants in incidence of cleft speech characteristics

As presented in table 8.8 all the subjects with cleft palate used some cleft speech characteristics. Most of them (19/21) used at least six of these characteristics in their speech, while the remaining two children, AM.M and P.D used three of the characteristics. The highest usage of cleft speech characteristics was observed in the speech of two children, M.A and AS.R who demonstrated production of eleven CSCs in their speech. It is interesting that seven of the children (M.R (AM.E A.ML M.H AM.H, M.A and HD.M,) who demonstrated linguolabial realisation, also demonstrated interdental articulation or dentalisation. Moreover, all four children (M.R, H.S, M.A and AS.R), who used pharyngeal realisations, also used glottal realisations in their speech. Furthermore, six participants (M.R, H.S, M.G, M.A, K.SH and HD.M), who presented using nasal fricative realisation, also used glottal realisation in their speech.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No | Participants | Age | Cleft type | Oral CSCs | | | | | | | | | |  | Non-oral CSCs | | Passive CSCs | | | | | | Total |
| Anterior | | | | | | | | Posterior | |  |
| Ling. | Interdental | Dentalis | lateral | lateralis | palatal | Palatalisation | Double art | Backing to velar | Backing to uvular | pharyngeal | Glottal | Active nasal fricative | Weak nasalised | Nasal realisation of plosive | Nasal realisation of fricative | Absent pressure consonant | | Gliding of fricative/affricate |
| 1 | AM.E | **5;0** | **UCLP** | ✔ |  | ✔ |  | ✔ | ✔ |  |  |  | ✔ |  |  |  |  |  |  |  | | ✔ | 6 |
| 2 | HD.M | **5;0** | **UCLP** | ✔ | ✔ |  |  |  | ✔ |  |  |  |  |  | ✔ | ✔ |  | ✔ | ✔ |  | |  | 7 |
| 3 | AM.H | **5;1** | **BCLP** | ✔ | ✔ | ✔ |  |  | ✔ |  |  |  |  |  | ✔ |  | ✔ |  |  |  | |  | 6 |
| 4 | H.S | **5;1** | **ICP** |  |  |  |  |  | ✔ |  |  |  |  | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |  | |  | 7 |
| 5 | D.M | **5;2** | **BCLP** |  |  |  |  | ✔ | ✔ |  |  |  |  |  | ✔ |  | ✔ | ✔ | ✔ |  | | ✔ | 7 |
| 6 | A.R | **5;3** | **ICP** |  |  |  | ✔ | ✔ | ✔ |  |  | ✔ |  |  | ✔ |  |  |  |  |  | |  | 5 |
| 7 | M.A | **5;4** | **BCLP** | ✔ | ✔ |  |  |  | ✔ |  |  | ✔ |  | ✔ | ✔ |  | ✔ | ✔ | ✔ |  | |  | 9 |
| 8 | A.ML | **5;4** | **UCLP** | ✔ |  |  |  |  |  |  |  |  |  |  | ✔ |  | ✔ |  |  |  | |  | 3 |
| 9 | MH.N | **5;9** | **BCLP** |  | ✔ |  |  | ✔ | ✔ |  | ✔ | ✔ |  |  |  |  | ✔ | ✔ |  |  | | ✔ | 8 |
| 10 | P.D | **5;9** | **UCLP** |  |  |  |  |  |  |  |  |  |  |  |  |  | ✔ |  |  |  | |  | 1 |
| 11 | AM.M | **5;11** | **UCLP** |  |  |  |  |  |  |  |  | ✔ |  |  |  |  | ✔ |  |  |  | |  | 2 |
| 12 | M.H | **6;1** | **BCLP** | ✔ | ✔ | ✔ |  |  | ✔ | ✔ |  |  |  |  |  |  |  |  |  |  | | ✔ | 6 |
| 13 | R.E | **6;1** | **ICP** |  |  |  | ✔ |  | ✔ |  |  | ✔ |  |  | ✔ |  |  | ✔ |  |  | | ✔ | 6 |
| 14 | M.N | **6;3** | **ICP** |  |  |  |  | ✔ |  |  | ✔ | ✔ |  |  | ✔ |  |  | ✔ |  |  | |  | 5 |
| 15 | F.R | **7;1** | **BCLP** |  | ✔ |  |  | ✔ | ✔ |  |  |  |  |  | ✔ |  | ✔ |  | ✔ |  | | ✔ | 7 |
| 16 | M.R | **7;3** | **ICP** | ✔ | ✔ |  |  |  | ✔ |  |  |  |  | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |  | |  | 9 |
| 17 | AS.R | **7;8** | **UCLP** |  | ✔ |  | ✔ | ✔ | ✔ |  |  | ✔ |  | ✔ | ✔ |  | ✔ |  |  |  | | ✔ | 9 |
| 18 | N.F | **8;1** | **ICP** |  |  |  |  |  | ✔ |  |  |  |  |  |  | ✔ | ✔ | ✔ | ✔ |  | |  | 5 |
| 19 | K.SH | **8;4** | **UCLP** |  |  |  |  |  | ✔ |  |  |  |  |  | ✔ | ✔ | ✔ | ✔ | ✔ |  | | ✔ | 7 |
| 20 | R.N | **9;4** | **UCLP** | ✔ |  |  |  | ✔ |  |  |  | ✔ |  |  | ✔ |  | ✔ | ✔ | ✔ |  | |  | 7 |
| 21 | M.G | **9;9** | **UCLP** |  | ✔ |  |  | ✔ |  |  |  | ✔ |  |  | ✔ | ✔ | ✔ |  |  |  | |  | 6 |
| Total |  | | | 8 | 9 | 3 | 3 | 9 | 15 | 1 | 2 | 9 | 1 | 4 | 15 | 6 | 15 | 11 | 9 | 0 | 8 | |  |

Table 8.8 Summary of speech characteristics realised by each participant with a cleft palate

## 8.4 Effects of consonant type on occurrence of cleft and non-cleft speech characteristics

This section addresses the following research question:

How are different target consonants affected in the speech of Farsi-speaking children with cleft palate?

The relevant results are presented in Table 8.9.

In terms of oral consonants, /z/ was the most affected consonant whereas; /j/ was the least affected: /z/ was changed to a different realisation 29 times while /j/ which is not a pressure consonant was affected only four times. The only non-oral consonant with no changes was /ʔ/ in this study. After /z/, /d/ was the second most affected consonant.

Regarding the consonants classes, plosive /d/ and /ɡ/ were the most affected plosive consonants with 26 and 25 changes respectively. Moreover, fricative /z/ and /ʒ/ were changed to different realisations 30 and 23 times respectively. Affricate /ʤ/ was affected more than affricate /ʧ/. It is interesting that voiced consonants were affected slightly more than voiceless ones. Table 8.8 shows that target voiced plosive /d/ was produced as different realisations 26 times while voiceless plosive /t/ was changed 21 times. It can be seen in other voiced and voiceless consonant pairs which are /s/ 21 times while /z/ 29 times, /k/ 16 times while /ɡ/ 25 times and also /ʃ/ 13 times while /ʒ/ 23 times. Therefore, the total number of realisations for voiced targets is slightly greater than the total of realisations for voiceless targets.

In terms of which cleft speech characteristics affected the consonants, glottal articulation affected the greatest number of consonants (18). In contrast, backing to uvular affected only one consonant. Palatal articulation, which was the most common compensatory articulation and was realised 77 times in the speech of participants, affected 17 consonants, while glottal articulation, which was realised 52 times, affected 18 Farsi consonants.

With regards to non-cleft developmental realisations, /ɾ/ was the most affected consonant, being realised as an approximant.

Similar results were observed in a number of previous studies. According to Peterson-Falzone, Hardin-Jones and Karnell (2001), several studies demonstrated that production of pressure consonants is more difficult than other classes of consonants for children with a cleft palate (Van Demark, 1969; Van Demark *et al.,* 1979). Albery and Grunwell (1993) showed that /s, z/ were the two most vulnerable consonants in the speech of 5 and 10 year-old participants with a cleft palate. Fricatives are frequently misarticulated based on these studies. Watson, Sell and Grunwell (2001) and Peterson-Falzone et al. (2006) suggested that pressure consonants, both voiced and voiceless, are vulnerable because the speaker needs to achieve a tight closure of the velopharyngeal port. Therefore, production of pressure consonants is more difficult for the children with a cleft palate and VPI. Furthermore, a particular shape and the position of tongue is another requirement for production of alveolar fricatives /s, z/ (Kent, 1992). /d/ was the most affected consonant after /z/. This result is similar to the result of other studies in English (Van Demark *et al.,* 1979), Arabic (Al-awaji, 2014) and Amharic (Mekonnen, 2013) as /d/ is one of the pressure consonants.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Realisations | Consonant targets | | | | | | | | | | | | | | | | | | | | | | | Number of consonants affected |
|  | p | b | t | d | k | ɡ | G | ʔ | ʧ | ʤ | m | n | f | v | s | z | ʃ | ʒ | x | h | j | l | r |  |
| Linguolabial articulation | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5/23 |
| Interdental/Dentalisation | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 4 | 0 | 9/23 |
| Lateral/Lateralisation | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 3 | 4 | 0 | 4 | 2 | 1 | 0 | 11/23 |
| Palatal/Palatalisation | 1 | 0 | 1 | 4 | 7 | 10 | 5 | - | 7 | 6 | 0 | 2 | 1 | 1 | 7 | 6 | 7 | 7 | 0 | 0 | - | 0 | 4 | 16/21 |
| Double articulation | 0 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5/23 |
| Backing to velar | - | - | 2 | 4 | - | - | - | - | - | - | - | 0 | - | - | 0 | 1 | - | - | - | - | - | 0 | 0 | 4/7 |
| Backing to uvular | - | - | - | - | 0 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1/2 |
| Pharyngeal articulation | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 7/23 |
| Glottal articulation | 4 | 0 | 3 | 0 | 2 | 6 | 6 | - | 1 | 5 | 2 | 1 | 4 | 1 | 2 | 1 | 1 | 2 | 8 | - | 1 | 0 | 2 | 18/21 |
| Nasal fricative | - | - | 3 | - | - | - | - | - | - | - | - | - | 1 | 0 | 6 | 1 | 2 | 0 | 0 | 0 | - | - | - | 5/9 |
| Weak nasalised articulation | 2 | 3 | 3 | 6 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 12/23 |
| Nasal realisation of plosive | 0 | 5 | 3 | 5 | 2 | 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5/7 |
| Nasal realisation of fricative | - | - | - | - | - | - | - | - | - | - | - | - | 0 | 3 | 2 | 4 | 0 | 1 | 0 | 0 | - | - | - | 4/7 |
| Gliding of fricative/affricate | - | - | - | - | - | - | - | - | 2 | 1 | - | - | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | - | - | - | 5/9 |
| Developmental realisation | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 5 | 0 | 0 | 2 | 1 | 0 | 5 | 0 | 2 | 1 | 0 | 0 | 0 | 10 | 12/23 |
| Atypical articulations | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 7/23 |
| Frequency of each affected consonant | 8 | 8 | 21 | 26 | 16 | 25 | 18 | 0 | 13 | 19 | 2 | 13 | 12 | 10 | 21 | 29 | 13 | 23 | 13 | 4 | 4 | 11 | 16 |  |

Table 8.9 Prevalence of specific cleft speech characteristics affecting individual consonant targets.

Note: Not all consonants are susceptible to all errors. For example, nasal realisation of fricatives only applies to fricatives.

## 8.5 Relationship between age at the time of assessment and occurrence of cleft and non-cleft speech characteristics

## 

This section addresses the following question:

Is the occurrence of cleft and non-cleft speech characteristics related to the child’s age at assessment?

The age at assessment is another factor that is important in speech outcome (Lohmander & Olsson, 2004). As mentioned in chapter 2, it is clear that children with a cleft palate show different cleft speech characteristics (CSCs) at different ages. According to the literature, the time of starting school is a critical age for the children with speech difficulties (Bishop & Adams, 1990). Persisting speech difficulties are noted in children at 5 or 6 years old and beyond, and therefore their difficulties will not be resolved by the time of starting school (Pascoe *et al.,* 2006). Many studies in regard to all speech difficulties have attempted to identify the persistency of speech difficulties in the children based on the time of starting their education in order to assess and carry out the appropriate intervention. It should be noted that these studies have been carried out in the U.K. where most children start formal education about 4-5 years (Bishop & Adams (1990). This time for Farsi-speaking children in Iran is different. They enter school at about 6 years old. Therefore, in order to explore the effect of age at assessment, the participants in this study were grouped based on the age of starting school in Iran. The first group – the preschool group, - included children who were aged 5 to 6. The second group – the school group - included children aged between 6;1 and 9;11. This comparison in speech production does not aim to evaluate the effects of palatal surgery on the speech outcome because, firstly, the time and technique of palatal surgery for these children varied, and, secondly, they attended speech therapy sessions and had different types of intervention. Therefore, this research reports the nature of speech production of Farsi-speaking children with a repaired cleft palate irrespective of their clinical management up to the time of speech assessment. Because of the small number of subjects (21 children with a cleft palate), statistical tests could not be conducted. Hence simple descriptive statistics only are reported. Table 8.8 and 8.9 show the analysis of segmental realisations and also analysis of resonance and airflow, respectively. Both tables are categorised based on the chronological age of the children at the time of assessment.

### Age in relation to speech characteristics

figure 8.1 The relationship between cleft speech characteristics and age at the time of assessment.

Figure 8.1 shows the relationship between cleft speech characteristics and age at the time of assessment. All the children in both groups used at least one oral CSC in their speech. In comparison between anterior oral CSCs and posterior oral CSCs, there are no clear differences between two groups. All the school-age group children used anterior oral CSCs, while half of them used posterior oral CSCs in their speech. Similar results were seen in the speech of the pre-school age group. In terms of anterior oral CSCs, lateral realisations including lateral articulation and lateralisation were observed in 60% of the school-age group while 36% of the pre-school group used it in their speech. Moreover, the frequency of oral CSCs is more than non-oral CSCs. An unexpected finding is that non-oral CSCs were observed in the speech of 90% of the school-age group. It might be because in the past surgery was done on children when they were older. Although non-oral CSCs were present in the speech of most of children in the school-age group, only about half of the children in the pre-school age group used them in their speech. Furthermore, passive CSCs were identified in the speech of high numbers of the two groups.

### 8.5.2 Age in relation to resonance and airflow

**figure 8.2** Percentage of children with hypernasality based on the age of children at the time of assessment

figure 8.3 Percentage of children with nasal emission based on the age of children at the time of assessment

figure 8.4 Percentage of children with nasal emission based on the age of children at the time of assessment

figure 8.5 Percentage of children with grimace based on the age of children at the time of assessment

figure 8.6 Percentage of children with hypornasality based on the age of children at the time of assessment

According to figures 8.2 to 8.6, hypernasality was perceived in 50% of the older children though only 27% of the preschool group, which is in line with previous findings: Chapman (2008) noted that older children show more hypernasality than the younger ones. As a similar result was observed in nasal emission in comparing the two groups, it seems that there is a relationship between hypernasality and nasal emission and age. As reported in previous studies, the degree of hypernasality and nasal emission increase with the age of the children. Hyponasality was observed in the speech of only one child in the older group, while four participants in the younger group used a mild degree of hyponasality. Nasal turbulence and severe grimace, which were quite rare, were evident in both groups.

In general, although it is not possible to make definite and final statements on account of the small sample size, the following general trends can be noted. Hypernasality and nasal airflow were evident more in the speech of the children in the school-age group than in the children in the pre-school age group. Furthermore, according to the evidence, there might be a positive relationship between age and hypernasality, while there was no relationship between nasal turbulence and grimace and the age of children.

## 8.6 Relationship between cleft type and occurrence of cleft and non-cleft speech characteristics

This section addresses the following research question:

Is the occurrence of cleft and non-cleft speech characteristics related to the type of cleft that the child has?

Children with three types of cleft lip and palate were included in the study: six cases of isolated cleft palate (ICP); nine cases of unilateral cleft lip and palate (UCLP), and six cases of bilateral cleft lip and palate (BCLP). The occurrence of cleft speech characteristics, resonance and nasal airflow can be therefore compared based on type of cleft. However, the subgroup sizes are small and therefore results should be treated with caution.

As has been outlined in the literature review, there are many studies that show the effects of the type of cleft on speech production in individuals with cleft palate (e.g., Riski & DeLong, 1984; 1985; Peterson-Falzone, 1990; Dalston, 1992; Albery & Grunwell, 1993; Karling *et al.,* 1993; Hardin-Jones *et al.,* 2003). Many of these studies found a significant relationship between the severity of cleft-type and the speech output. Albery and Grunwell (1993) stated that there are major differences in articulatory patterns between different types of cleft. However, as their participants were aged between 2;6 and 10, they noted that those significant differences might be also associated with age. Hardin-Jones et al. (2005) reported that while there is a strong relationship between cleft-type and number of children who are referred to speech therapy, there was no significant difference in prevalence of compensatory articulations between children with different types of cleft palate. This is consistent with a study by Chapman et al (2008), who compared speech outcomes of two groups of children with UCLP and BCLP. Results revealed that there were no significant differences between their speech outcomes based on cleft-type.

### 8.6.1 Type of cleft palate in relation to cleft speech characteristics

figure 8.7 Occurrence of cleft speech characteristics based on type of cleft lip and palate

According to the data figure 8.7, in the present study, all the participants in the three groups behaved similarly in respect to using anterior and posterior oral CSCs in their speech. This result is similar to the studies of Hardin-Jones and Jones (2005) mentioned above. In the present study all the children with UCLP and BCLP were observed using passive CSCs, while 83% of the children in ICP group used them. There is no obvious difference between UCLP and BCLP in this study, which is consistent with Chapman, et al. (2008) In the present study, non-oral CSCs were perceived in the speech of all the children in the ICP group, whereas 67% of the children in the other two groups used them in their speech, suggesting that there may be some difference between children with ICP and BCLP, the former showing more extensive use of non-oral CSCs such as glottal articulation.

As the number of participants in each group, based on type of cleft, was small in this study, making a comparison between them is difficult. According to previous studies, there are many factors which are associated with speech outcomes of children with different types of cleft, for example, structural deficits such as dental and occlusional problems (Peterson-Falzone, 2001).

### 8.6.2 Type of cleft in relation to resonance and nasal airflow

figure 8.8 Occurrence of atypical resonance and airflow based on type of cleft lip and palate

Similar to the ICP group, the majority of participants with a repaired unilateral cleft lip and palate demonstrated nasal emission. Moreover, 33% of them showed hypernasality and hyponasality in their speech. It is notable that no children from the BCLP group showed nasal turbulence. It might be because the BCLP children have more VPD and therefore are less likely to have a narrow VP gap causing turbulence.

According to figure 8.8, the majority of children in the ICP and UCLP groups demonstrated nasal emission. Moreover, hyponasality was noted in the speech of three children in the UCLP group.

## 8.7 Summary

The four principal research questions in this chapter were:

Research Question 5: What is the relative frequency of occurrence of different cleft speech characteristics in the speech of Farsi-speaking children with cleft palate?

The results revealed that palatal articulation and glottal articulation are more frequent in the speech of Farsi-speaking children whereas, backing to uvular and absent pressure consonants were less frequent. The result suggests that most cleft speech characteristics are not remarkably different from those reported in the speech of English-speaking children with a cleft palate.

Research Question 6: How are different target consonants affected in the speech of Farsi-speaking children with cleft palate?

/z, d/ was the oral consonant which was most affected in the speech of participants in this study. In terms of consonant classes, plosives consonants were the most affected class. The cleft characteristic that affected the greatest number of target consonants was glottal articulation.

Research Question 7: Is the occurrence of cleft and non-cleft speech characteristic related to the child’s age at assessment?

There was little difference in the overall patterns of speech regarding the type of cleft and age of the children at the time of assessment, though there was some indication of more frequent occurrence of cleft speech characteristics in the older (school-age) group.

Research Question 8: Is the occurrence of cleft and non-cleft speech characteristic related to the type of cleft that the child has?

There was little difference in the overall patterns of speech regarding the type of cleft and age of the children at the time of assessment.

The next chapter will consider cross-linguistic similarities and differences, by comparing features of speech production identified in Farsi-speaking children with cleft palate to those that have been reported for other languages.

# Chapter 9 Discussion and cross-linguistic comparison

## 9.1 Introduction

The findings from results in chapter 6, 7 and 8 are discussed in this chapter, in relation to the second research question from Chapter 5:

Reseach Question 2: What are the similarities and differences between characteristics of cleft palate speech in Farsi and other languages, especially English?

Consideration of cross-linguistic similarities and differences is important as previous studies have identified theoretical issues such as universality of cleft speech characteristics versus language specific aspects. The cross linguistic theme is addressed in each section of the following discussion about the findings for all the other research questions. The first section of this chapter reviews the specific cleft speech characteristics identified in Farsi-speaking children with a repaired cleft palate. Afterward, these CSCs are compared with the features which are reported in other languages. In addition the most and least affected consonants, manner and place of articulation, are presented in this first section of the chapter. The second part of the chapter reviews findings from the analysis of the phonological processes in the typically-developing Farsi-speaking children in the present study. These are compared to processes reported for typically-developing children learning English and other languages. Finally the use of these processes by children born with a cleft palate, speaking Farsi and other languages, is discussed.

## 9.2 Cross-linguistic similarities and differences in cleft speech characteristics

Cleft speech characteristics in the speech of children with a cleft palate, presented in chapter 7 include: linguolabial and dental articulation, lateral and palatal articulation, double articulation, backing, pharyngeal and glottal articulation, active nasal fricative, weak nasalised articulation, nasal realisation of plosives and fricatives, absent pressure consonants, gliding of fricatives/affricates, dentolabial articulation and retroflex articulation. Most of these speech characteristics are very familiar in many languages, whereas some of them might be found particularly in Farsi.

### 9.2.1 Linguolabial and interdental articulation

As reported in chapter 7, linguolabial and dental articulations were identified in this study. While interdental consonants have phonemic status in many languages, such as English and Arabic, they are absent from Farsi (Yavas, 2006) and so their production can be considered to be a misarticulation. These two types of misarticulation are extremely common across various languages, even languages like English that have dental consonants phonemically, where interdental articulation is a common developmental realisation of target alveolar fricatives **(**McWilliams, Morris, and Shelton, 1990; Trost-Cardamone, 1990; Brøndsted *et al.,* 1994; Sell *et al.,* 1994, 1999; Howard, 2011). In some cases interdental articulation may be a consequence of a class Ⅲmalocclusion (Stengelhofen, 1993; Atkinson & Howard, 2011): the tongue may inevitably contact the teeth and upper lip because of its natural posture in relation to the upper jaw. Albery (1991) proposed that when the maxillary space is limited, the tongue has little room to move for accurate production of alveolar consonants. As a result, the tongue tends to have a forward movement. When the tip of the tongue moves forward, it results in dentalised consonants. In addition, the pattern of tongue-muscle development is different with an open cleft before surgery and there may be less opportunity for developing tip versus back lingual movement. Therefore, this could be a further reason to produce the linguolabial, dental or interdental consonants. In the light of these explanations of interdental articulation and its use by speakers with cleft palate across different languages, it seems likely that the presence of this feature in eight of the Farsi-speaking cleft group derives from underlying physiological causes, rather than being a Farsi-specific phenomenon.

### 9.2.2 Lateral and palatal articulation: lateral articulation, lateralisation, palatal articulation, palatalisation

Gibbon and Hardcastle (1989) in their EPG study of lingual contact stated that posterior tongue contact might lead the airflow to be directed either to the centre or around the sides of tongue. Therefore, anterior fricative consonants such as /s, z, ʃ/ are realised as lateral fricatives such as [ɮ] or palatal fricatives such as [ҫ].

Lateral articulation and lateralisation are frequently reported in the speech of individuals with a cleft palate in many languages (e.g. in English: Harding & Grunwell, 1996; in Arabic: Shahin, 2006 and Al-Tamimi *et al.,* 2011; in Amharic: Mekonnen, 2013).

Palatal articulation was identified in the speech of 15 children, making it one of the most common cleft speech features found in this study. The affected consonants are fricative targets /s, z, ʃ, ʒ/, affricates /ʧ, ʤ/, tap /ɾ/ and approximant /l/. Replacing /ɾ/ with [j] is common in speech of typically-developing children who speak Farsi. Therefore, this particular realisation in this study may be a persisting immaturity which appears as a typical developmental pattern. Palatal articulation is considered to be one of the cleft speech characteristics that occurs frequently in the speech of individuals with a cleft palate who speak different languages (e.g. in English: Harding & Grunwell, 1996).

There are various factors that may cause or contribute to lateral and palatal articulation, including hard palate abnormalities such as fistulae, dental abnormalities and malocclusions such as class Ⅲ maloclusion. Harding and Grunwell (1996) stated that class Ⅲ malocclusion reduces the space for the tongue. Therefore, the tongue has to adapt to any unusual alveolar shapes. This might be the reason for realisation of target alveolar as palatal and lateral articulation in the current study, as class Ⅲ malocclusion has been observed in two of the participants with a cleft palate. Gibbon and Hardcastle (1989) proposed that decreased sensation in the alveolar or palatal region and hearing loss could be other factors that cause lateral and palatal articulation in the speech of individuals with a cleft palate. In addition, Harding and Grunwell (1996) suggested that if occlusal abnormalities are not the cause of the palatalisation and lateralisation, other factors such as alveolar fistulae, sensory loss in the palatal mucosa, dental overcrowding, hearing status and perceptual issues in early development, or even early tongue movement patterns established for feeding, are the possible reasons for these atypical realisations. Therefore, these factors excluding alveolar fistulae might be the cause of such misarticulations in the current study.

Moreover, there are some studies that focused on the relationship between realisation of lateral and palatal articulation, and the type of cleft palate. Michi et al. (1990) and Yamashita et al. (1992) reported that the tendency to have atypical lingual movement in children with UCLP and BCLP is more than children with ICP. The current study supports Michi et al. (1990) and Yamashita et al. (1992)’s research, as all six children with BCLP in this study demonstrated atypical lateral and palatal articulation in their speech.

In summary, lateralisation and palatalisation as secondary articulations as well as lateral and palatal articulations have been reported in the speech of children with cleft palate in English and other languages (Sell *et al.,* 1999). Researchers have attributed the occurrence of these features to physical causes related to the cleft. Therefore their occurrence in almost half the children in the cleft group in the present study can plausibly be attributed to the effects of the cleft itself rather than to an adaptation to specific features of Farsi phonology.

### 9.2.3 Double articulation

Double articulation as a cleft speech characteristic has been reported in different languages e.g. in English: Gibbon and Crampin, 2002; Howard, 2004, 2013; in Cantonese: Whitehill *et al.,* 1995; in Swedish: Persson *et al.,* 2006; and in Amharic: Mekonnen, 2013.

In relation to English-speaking children, double articulation was found by Harding and Grunwell (1996), who reported that double articulation, similar to backing, was observed most frequently when the target is alveolar plosive in the group of children who had delayed hard palate repair. Again with reference to English-speaking children, Gibbon et al. (2007) stated that the most commonly reported type of double articulation involves a glottal or pharyngeal restriction which occurs at the same time with a closure at higher level in the vocal tract such as bilabial constraint or tongue-palate stricture in the oral cavity.

Contrary to the findings of Gibbon et al. (2007), no double articulations involving a glottal or pharyngeal restriction were found in the present study. However, identifying double articulation in the speech of individuals with a cleft palate through perceptual analysis alone is challenging and for this reason the author and one of the supervisors (an expert listener) listened jointly to some cases. According to one study that used EPG as an additional assessment tool (Gibbon & Crampin, 2002), double articulation was visible in palatograms but imperceptible in the speech of three out of 27 participants with a cleft palate. Therefore, this could be the case with the participants with a cleft palate in this study.

### 9.2.4 Backing

Occurrence of backing by nine of the fifteen children in this study of Farsi-speaking children is in line with a study of English-speaking children by Trost (1981), who proposed that the backing pattern affects anterior oral consonant targets. Additionally, two children aged 5;6 and 9;4 used backing to velar for a target alveolar tap /ɾ/. Malocclusion class Ⅲ was observed in both of these children. Dental and/or occlusal anomalies could be the reason for backing where normal tongue position is impossible (Golding-Kushner, 1995). In addition, reduced sensation of the oral cavity related to scar tissue after palatal surgery might be the cause of occurrences of backing patterns in the speech of children with a cleft palate (Hardcastle *et al.,* 1989; Moller, 1990; Russell & Grunwell, 1993; Nagarajan *et al.,* 2009). One child used velar approximant [ɰ] for alveolar fricative /z/. Substituting approximant for fricative in this study might be because of the existence of a history of hearing problems leading to occurrences of backing patterns (Whitehill *et al.,* 2003). Although there is not a clear relationship between otitis media with effusion (OME) and speech development, the risk of speech and language problems in children with a cleft palate who suffered from early OME is significant (Hall & Hill, 1986; Bamford & Saunders, 1990).

Backing is reported frequently in different languages such as English (Harding & Grunwell, 1996; Hardin-Jones & Jones, 2005), Arabic (Shahin, 2006; Al-Tamimi *et al.,* 2011; Alawaji, 2014) and Amharic (Mekonnen, 2013). In an Arabic study (Al-awaji, 2014) bilabial, dental, alveolar, postalveolar and emphatic targets were backed to velar and uvular places of articulation. Mekonnen (2013) noted that most participants in his Amharic study used backing of oral targets. This widespread use of backing in different languages suggests that its use by nine of the children in this study is most likely due to physiological causes rather than to Farsi phonology.

### 9.2.5 Glottal and pharyngeal articulation

While glottal and pharyngeal articulations are classified as backing patterns in some studies such as Henningsson et al. (2009), Sell et al. (1999) categorised them as non-oral. As mentioned before in chapter 4, as this study is based on the study of Sell et al. (1999), glottal and pharyngeal articulations are included in the non-oral cleft speech characteristics category.

Pharyngeal and glottal articulations were thus found to be common cleft speech characteristics in this study. This finding supports other studies in different languages such as English (Hardin-Jones & Jones, 2005), and Amharic (Mekonnen, 2013). However, pharyngeal articulation has not been reported in Arabic (Al-awaji, 2014). Al-awaji (2014) suggested that ‘’the specific characteristics of the Arabic phonological system have influenced the compensatory strategies adopted and avoided by the children.”(Al-awaji, 2014, p.366)

There are many possible causes of occurrences of pharyngeal and glottal articulations. The first one is the existence of past or present velopharyngeal insufficiency (McWilliams *et al.,* 1990; Chapman, 1993; D’Antonio & Scherer, 1995, Whitehall *et al.,* 2003). Signs of VPI have been found in the speech of most of the 15 children in this study. Glottal and pharyngeal articulations in the speech of individuals with a cleft palate may be the result of an unconscious attempt to achieve valving at a point upstream of the velopharyngeal valve before losing the pressure through the velopharyngeal port (Whitehill *et al.,* 2003). The second possible reason is existence of past or present fistulae or residual cleft palate (Henningsson & Isberg, 1990; LeBlanc, 1996; Lohmander *et al.,* 2002, Whitehill *et al.,* 2003). Similar to the case of VPI, the speaker with an oronasal fistula subconsciously tries to achieve a valve at a posterior position of the fistula to prohibit air escaping via the nasal cavity (Whitehill *et al.,* 2003).

As mentioned in chapter 4, both glottal stop and the voiceless glottal fricative /h/ are members of the Farsi consonant system although the glottal stop is restricted in its occurrence.

In summary, glottal and pharyngeal articulations have been reported in the speech of children with a cleft palate in many languages such as English (Sell *et al.,* 1999), and Amharic (Mekonnen, 2013). Thus occurrence of these features in the speech of most Farsi-speaking children with a cleft palate in this study might be due to physical causes related to the cleft palate in conjunction with absence of pharyngeal articulation in the Farsi consonant system.

### 9.2.6 Nasal fricatives

A nasal fricative occurs as a result of articulatory constriction stopping airflow through the oral cavity and directing it nasally (Harding & Grunwell, 1998). This is commonly reported across different languages especially in English (Sell *et al.,* 1999; Peterson-Falzone *et al.,* 2001). Sell et al. (1999) stated that active nasal fricatives can occur without other evidence of nasal emission on other pressure consonants and without hypernasality. However, they proposed that making a distinction between active and passive nasal fricatives from transcription alone is challenging. Nose-holding can be used as an assessment tool in a live assessment (Sell *et al.,* 1999).

Absence of nose-holding assessment is a limitation of the present study. Therefore, other signs of velopharyngeal dysfunction (VPD) were used to distinguish between passive and active nasal realisation of fricatives. For example, when voiceless consonants such as /p, t, k/ in the speech sample are realised without audible nasal emission and the nasal resonance is normal, the nasal realisation of the fricative is categorised as an active nasal fricative.

Substitution of [m, n] for fricative targets might be evidence of a history of hearing problems in this study based on the study of Peterson-Falzone et al. (2001). Sell et al. (1994) proposed that the occurrence of passive nasal fricative is commonly related to velopharyngeal inadequacy. Moreover, they stated that active nasal fricative might be due to deviant learning. However, Hutters and Brøndsted (1987) associated nasal fricative with residual cleft in palate and/or fistulae. Therefore, occurrences of passive nasal fricatives in the speech of nine of these ten children in this study are likely to be because of VPI or deviant learning.

Although Sell et al. (1999) stated that only fricative targets are realised as active nasal fricatives in cleft palate speech, two participants in this study substituted a nasal fricative for the plosive target /t/ in SIWI and SIWW positions of the word. It is notable that a similar observation was seen in Arabic (Al-awaji, 2014). Substitution of pressure consonants, such as plosives, fricatives and affricates with nasal emission/turbulence, might be due to structural insufficiency and/or weakened ability to achieve velopharyngeal closure in the individual with a cleft palate. Therefore, occurrence of nasal fricative for plosive /t/ in this study might be because of structural abnormality. However, frication of plosives has also been attributed to hearing loss so it is possible that these two Farsi-speaking children may have a history of high frequency hearing loss. Unfortunately this information was not available to the researcher. However, the fact that this type of characteristic is reported only for Arabic and Farsi, suggests that the occurrence of the nasal fricative might instead be related to the language.

### 9.2.7 Weak and/or nasalised consonants

A common passive cleft speech characteristic found in different studies is weak and/or nasalised realisation. Eight children showed signs of VPD in this study. It is interesting that of these, seven additionally used weak articulation. These findings seem to support those of Hutters & Bronsted (1987), Harding & Grunwell, (1998) and Henningson et al. (2008). Henningson et al. (2008) stated that it occurs when perceptually, the speech sound holds its identity but it loses some aspects of oral quality. Some studies on the speech of children with a cleft palate in English and Danish report the same finding that plosives are the most common weak realisations (Henningson et al. (2008); Henningson & Willadsen (2011). Weak and/or nasalised articulation is often observed in the speech of individuals with a cleft palate due to velopharyngeal insufficiency (Hutters & Bronsted, 1987; Harding & Grunwell, 1998) or structural anomalities related to the cleft palate or VPI (Henningson *et al.,* 2008). Henningson et al. (2008) proposed that weak and/or nasalised articulation might co-occur with ratings of moderate or severe hyper nasality. Therefore, this symptom is likely to be evidence of VPD in the Farsi-speaking children.

### 9.2.8 Nasal realisation of plosives

This feature is frequently reported in the literature across English and Danish (Hutters & Bronsted, 1987; Harding & Grunwell, 1998). Occurrence of nasal realisation of plosives is reported to be related to a lack of intra-oral pressure (Sell *et al.,* 1999) or it might be attributed to residual cleft fistulae when it affects bilabial and alveolar target consonants (Hutters & Brøndsted, 1987; Harding & Grunwell, 1998). Ten of the eleven children who used nasal realisation of plosives, showed other passive CSCs in their speech. Therefore, this feature might be a sign of VPD in these children. Thus, it can be concluded that the presence of nasal realisation of plosive in this study supports the findings in other cleft studies reported above.

### 9.2.9 Gliding of fricatives/affricates

Although there is not a considerable amount of research to date related to gliding of fricatives and affricates, it is listed as a cleft characteristic in English (Sell *et al.,* 1999). As five children replaced /ʒ/ with [j] in SIWI in the word /ʒɒke'te/, it could be because the /ʒ/ is the initial sound of the weak syllable and it is more likely not to have been clearly perceived. Therefore, the children might have perceived /ʒ/ as [j]. One participant realised gliding of fricative /z/ in all three positions of the word. He misperceived most fricatives /f, v, s, z, ʃ / in his speech. Therefore realisation of gliding of fricative can be because of auditory perception. In addition, Sell et al. (1999) suggested that this type of cleft speech characteristic can also be a developmental process which is persistent and continues due to the history of cleft palate and associated hearing problems. Presence of it in the speech of eight of the Farsi-speaking cleft group supports the conclusions of Sell et al. (1999) for English. However, gliding of fricatives/affricate have not been reported in Arabic due to specific Arabic phonological system (Al-awaji, 2014).

### 9.2.10 Retroflex articulations

As retroflex consonants are not in the Farsi phonemic system, it might be due to structural anomalies that are related to cleft palate such as a high arched palate or it could be a therapy effect. This misarticulation has not been mentioned before in the cleft literature. This might be because this has not been frequent enough to be associated with cleft palate in other languages. Retroflex articulation is a language-specific speech feature that might be associated with the phonetic and phonological systems of Farsi. This data indicates that retroflex articulation could be included as a cleft characteristic in the Farsi version of GOS.SP.ASS.

### 9.2.11 Dentolabial articulations

Class Ⅲmalocclusion was visible in this child. This type of articulation is reported as an uncommon feature and could be occurring because of occlusal problem (Howard, 2011).

### 9.2.12 Vowels

There are few studies in any language that examine vowel articulation in the speech of individuals with a cleft palate. Gibbon et al. (2010) stated that this might be due to the view that the ability to produce vowel sounds in cleft speech is mostly unaffected. As mentioned in chapter 7, hypernasality was frequently perceived in the production of vowels in this study. Some studies have suggested that increased nasalisation might cause atypical realisation of vowels because of the position of the tongue (Yamashita & Michi, 1991; Gibbon *et al.,* 2005; Howard, 2012). Using the perceptual technique might not identify these types of misarticulation in vowels. Therefore, more consideration to vowels is needed to improve the understanding of the quality and features of cleft speech. Acoustic analysis may be helpful in this respect.

### 9.2.13 Summary of cleft speech characteristics in the Farsi data

Farsi-speaking children with a repaired cleft palate, in this study, showed a range of cleft speech characteristics in their speech. Some of these features are likely to be due to structural defects. These include: linguolabial and dental articulations, lateral and palatal articulations, double articulation, backing patterns, glottal and pharyngeal articulations, nasal fricative, weak and/or nasalised consonants, nasal realisation of plosive/fricative and gliding of fricative/affricate. These features were previously reported in studies of other languages especially English. Some of these features, such as backing to uvular and absent pressure consonant, were observed less than others in the present study, possibly due to the phonology of Farsi. In addition, one novel atypical articulation, namely retroflex articulation, was reported in this study. This misarticulation has not been mentioned before in the literature, possibly because it has not been frequent enough to be associated with cleft palate in other languages. Retroflex articulation may therefore be a language-specific speech feature that is associated with the phonetic and phonological systems of Farsi.

### 9.2.14 Most and least affected consonants

Across all different positions of word in this study, the most affected consonant was the voiced alveolar fricative /z/. It was changed to different realisations 29 times. This finding supports previous studies (e.g., in English: Subtelny & Subtelny, 1959; Van Demark *et al.,* 1979; Albery, 1991, in Amharic: Mekonnen, 2013). They found that sibilant fricatives are affected more than non-sibilants. /s/ and /z/ were the most vulnerable consonants in the study of speech of children with a cleft palate aged between 5 and 10 years (Albery & Grunwell, 1993). It is clear from these studies that fricatives are frequently mispronounced. Howard (1995) reported that typically-developing children combine the upward movement of the tongue tip or blade and lateral margins of the tongue with the alveolar ridge to create a groove down the centre of the tongue. It may be difficult for children with a cleft palate to achieve the narrow central groove required for sibilants because of structural irregularities associated with cleft palate such as hard palate cleft or class Ⅲ malocclusion. Harding and Grunwell (1996) suggested that a class Ⅲ malocclusion could restrict a speaker’s ability to achieve a central groove between the tongue and the alveolus because the tongue rests in a relatively anterior position in relation to the upper jaw, leaving only limited space for the tongue to manoeuvre to produce the alveolar and post-alveolar speech sounds.

The least affected consonant in this study was the glottal stop [ʔ], as mentioned in chapter 8. Studies by Albery and Grunwell (1993) in English and Al-awaji (2014) in Arabic showed that non-oral consonants such as pharyngeals and glottals are the consonants that are the most accurately realised in cleft speech. This is likely to be because of the place of articulation, posterior to the cleft palate, and the fact that they do not require velopharyngeal closure.

In terms of manner of articulation, fricative, plosive and affricate were the most affected in this study. This finding supports studies in English such as Watson et al. (2001) and Peterson-Falzone et al. (2006). They both proposed that production of obstruents is challenging for children with a cleft palate because these sounds need high intraoral pressure and they are liable to be weakened or nasalized because of velopharyngeal dysfunction.

Regarding the place of articulation, alveolar consonants were most affected in this study. Studies in English and Danish reported that alveolars cross-linguistically are most affected (e.g., Brøndsted*, et al.,* 1994; Harding & Grunwell, 1993). These findings in Farsi and English are not in agreement with some languages such as Japanese and Amharic where production of alveolar /s/ is easier than post-alveolar /ʃ/ for Japanese and Amharic speakers (Li *et al.,* 2009, 2011; Mekonnen, 2008, 2013). The various results from different studies can be associated with the frequency of production of specific sounds in different languages. Edwards et al. (2004) stated that children can produce sounds which are used more in the language more accurately than less frequent sounds.

Moreover, the number of consonants in each language and the effects of cleft palate on their production should be taken into account. It was mentioned earlier that high-pressure consonants are vulnerable in the speech of children with a cleft palate. As the number of pressure consonants is different across languages according to the phonetic and phonological system of the language, the more high-pressure consonants in the language, the more compensatory errors in the speech. For example, English has 16 pressure consonants while Hawaiian has two pressure consonants. Therefore, it is predictable that English-speaking children with a cleft palate show more difficulties in their speech compared to Hawaiian-speaking children of the same age. This same thing happens in Farsi when compared to English. Farsi has 20 high-pressure consonants including allophones. Therefore, this might cause speech to be more challenging for Farsi-speaking children in comparison to English-speaking ones. On the other hand, speech might be less challenging for Farsi-speaking children in comparison to Arabic-speaking ones, as Arabic has many more high-pressure consonants such as emphatic sounds.

In summary, the findings of this study suggest that the affected place and manner of articulation is related to both structural abnormalities because of cleft palate and also the specific sound system of different languages.

### 9.2.15 Speech output in relation to age at the time of assessment

As described in chapter 8, this study explored the relationship between speech production in Farsi-speaking children with a repaired cleft palate, and their age, based on the time of starting their formal education (preschool-age children and school-age children). Results in the Farsi language are likely to be affected by the same variables as other languages. Although the number of participants was not big enough to achieve a firm conclusion, the results showed no relation between accurate production of consonants and age at the time of assessment. Cleft speech characteristics were observed in the speech of most children in the school-age group, whereas they were observed in the speech of around half of the children in the pre-school group. This is in contrast with previous studies in other languages that reported that occurrence of cleft speech characteristics decreases with age in the speech of individuals with a cleft palate (Lohmander *et al.,* 2011).

There is a general agreement in the literature that early surgery to close the palate often leads to a better speech outcome (Sell & Grunwell, (1993a); Hardin-Jones and Jones, (2005). Unfortunately there is very little available information about the time or technique of palatal surgery used with the participants in the present study. However, it is possible that surgery for children in the school-age group was carried out at a later age than for the pre-school group, due to improvements in the timing of surgery in the intervening years. If so, it can be hypothesised that later surgery would lead to a higher incidence of CSCs in the older group.

Additional factors such as different types of structural abnormalities, hospitalisations and hearing problems related to cleft palate may be the reason for some of the cleft speech characteristics in some of the participants in this study. Furthermore, the participants in this study attended speech therapy sessions and had different types of intervention. Because of the range of different factors potentially affecting speech outcome, and the relatively small and heterogeneous nature of the two groups, it is not possible to come to a firm conclusion about the relationship between age and incidence of cleft speech characteristics in Farsi-speaking children.

### 9.2.16 Speech output in relation to type of cleft

As reported in chapter 8, there was no consistent difference in the speech production of Farsi-speaking children based on type of cleft in this study. This result is consistent with previous studies of children speaking English (e.g. Hardin-Jones & Jones, 2005; Chapman, *et al.,* 2008). They stated that there is no noticeable relationship between type of cleft and the number of children who show compensatory articulations.

However, all UCLP and BCLP children in the present study manifested passive cleft speech characteristics in their speech but this was not true of cleft palate only children. This result reflects findings from a number of studies in English such as Van Demark and Hardin (1985), Albery and Grunwell (1993), Karling et al. (1993) and Hardin-Jones and Jones (2005). They reported that children with only cleft palate require less speech therapy intervention compared with UCLP and BCLP children because they show fewer speech sound errors in their speech. Additionally, some studies show that the greater the severity of cleft, the greater the impacts on speech production (e.g., Peterson-Falzone, 1990; Dalston, 1992; Karling *et al.,* 1993; Albery & Grunwell, 1993; Hardin-Jones *et al.,* 2003).

## 9.3 Developmental phonological processes with cross-linguistic comparison

Returning to the main aim, the speech characteristics of typically-developing children who speak Farsi are described in chapter 6. As the size of that typically-developing group is small, and previous studies about speech development in typically-developing children who speak Farsi are limited, data from both of these sources are used in order to identify typical and atypical patterns of speech development in the children with cleft palate.

In order to establish whether some atypical speech developments observed in the children with a cleft palate are appropriate for their age, the relationship between speech development and age is discussed.

### 9.3.1 Phonological processes in the speech of typically-developing Farsi-speaking children

Typically-developing children who speak Farsi use typical systematic simplifications as well as structural simplifications. This usage is similar to typically-developing children who speak English.

### 9.3.1.1 Fronting

Two types of fronting: post-alveolar fronting and velar fronting, were observed in the speech of three participants in the typically-developing group. Fronting is a common developmental phonological process in many languages such as English (Howard, 2007), Cantonese (So, 2007), and German (Fox, 2007), whereas it is very limited in some languages such as Arabic (Dyson & Amayreh, 2000), Finnish (Kunnari & Savinainen-Makkonen, 2007) and French (Rose & Wauquier-Gravelines, 2007). Post-alveolar fronting was seen in the speech of two children in the control group. They commonly realised post-alveolar fricatives /ʃ, ʒ/ as alveolar fricatives [s, z]. Velar fronting was observed in the speech of only one child aged 5;10 in the control group in both sentence repetition and single word positions. Damirchi (2008) reported that fronting is one of the common phonological processes in the speech of Farsi-speaking children and it disappears around 5 years of age, though fronting has not been categorised into post-alveolar and velar fronting in her study. Weiner (1979) stated that post-alveolar fronting is common in the speech of English-speaking children. Dodd et al. (2003) reported that fronting disappears around 4 years of age. Locke (1983) proposed that, in terms of articulation, production of the alveolar fricative /s/ is generally easier than the production of the post-alveolar fricative /ʃ/. There are other reports on cross-linguistic studies which are not in agreement with Locke (1983). For example, Li et al. (2009) stated that these types of language-specific differences in acquisition might be linked to differences between the languages in how the alveolar and post-alveolar fricatives contrast is produced. Furthermore, the prevalence of use of specific speech sounds is important in a language because children produce frequently used speech sounds in their language more accurately than those sounds that are less frequent (Edwards *et al.,* 2004; Munson *et al.,* 2005; Edwards *et al.,* 2011). As there is not a study on the rate of occurrence of speech sounds in Farsi, deciding on the reason for fronting in the speech of Farsi-speaking children is difficult.

### 9.3.1.2 De-affrication

Three out of five typically-developing children aged 6;7, 7;0, and 8;1 in the current study demonstrated de-affrication in their speech. They realised affricates /ʤ, ʧ/ as stops [t, d]. Studies reported in English (Dodd *et al.,* 2003) and in Arabic (Amayreh, 2003) show that de-affrication is common in the speech of typically-developing children. Dodd et al. (2003) stated that de-affrication disappears around 5 years of age in the speech of English-speaking children. Damirchi (2008) stated that de-affrication was observed in the speech of Farsi-speaking children. Although Damirchi reported that de-affrication is one of the processes that disappears around five years old, the three typically-developing children who used deaffrication in the current study are considerably older than that. She reported that some phonological processes such as de-affrication were observed after the age of five but in a very small proportion of her participants (about 1%), which led her to discount those results. The proportion in the present study is much higher (60%) but the total number of children is much lower (n = 5) compared to the study of Damirchi (2008). In summary, the occurrence of deaffrication in Farsi-speaking children merits further research, not least as Amayreh (2003) found that Arabic-speaking children use de-affrication until around the age of eight.

### 9.3.1.3 Lateral realisation of trill/tap

One child in this study substituted an alveolar approximant /l/ for alveolar tap/trill (lateral realisation of trill/tap) in all positions of word (SIWI, SIWW, SFWF). As noted earlier, the alveolar tap /ɾ/ has a trilled allophonic variant [r] in Farsi. The alveolar trill occurs at the beginning of a word or word-medially in loanwords of Arabic origin. One study in Farsi reports replacing of [l] for alveolar tap/trill in the speech of typically-developing children, which might disappear after the age of six (Ghasesin, 2006). Lateral realisation of a target trill/tap is generally observed in the speech of typically-developing children in many languages. Regardless of the language, some studies reported that production of /r/ is one of the most difficult consonants (Recasens, 1991; Ladefoged & Maddieson, 1996; Solé, 2002). This might be because production of an alveolar trill needs an accurate control of aperture and airflow with minimal deviation (Recasens, 1991; Ladefoged & Maddieson, 1996; Solé, 2002). Regarding cross-linguistic similarities and differences, many studies in other languages shows that producing /r/ is difficult for the children who speak those languages such as Hindi (Srivastava, 1974); Igbo (Nwokah, 1986); Quiche (Pye *et al.,* 1987); Portuguese (Yavas & Lamprechrt, 1988); Italian (Bernthal & Bankson, 1988); Spanish (Carballo & Mendoza, 2000); Polish (Łobacz, 2000); Finnish (Savinainen-Makkonen & Kunnari, 2004); Thai (Lorwatanapongsa & Maroonroge, 2007), Amharic (Mekonnen, 2008) and Arabic (Ayyad, 2011; Alawaji, 2014).

### 9.3.1.4 Other developmental phonological processes

Other common developmental processes, such as final consonant deletion or stopping of alveolar fricative and post-alveolar fricative, which are common in many languages such as English and Arabic were not found in the speech of the 5-10 year-old typically-developing group in the present study. The age of elimination of stopping is between 3 to 5 years in these languages (Dodd *et al.,* 2003). Therefore, the reason why these processes were not found in this study might be due to the age range of the children. Damirchi (2008), in her study, found that stopping disappears between 3;6 to 4 years in the speech of typically-developing children who speak Farsi. Final consonant deletion was found in the speech of only one child aged 6;7 in the typically-developing group, on just one occasion. He failed to produce post-alveolar plosive /d/ from the final position of the utterance. Grunwell (1982) and Bowen (1998) stated that final consonant deletion disappears by 3;3 to 3;6 years in the speech of English-speaking children. There is no study in other languages that demonstrates this phonological process remaining, after 4 years of age. Damirchi (2008) found that it disappears in the speech of typically-developing Farsi-speaking children at around 3;6. As the age of the child is 6;7, and he used final consonant deletion only in the SFWF in utterance final position, it is possible that it is because of the length of the speech sample - which is a sentence of 8 syllables. Moreover, he may have put his oral articulators in the correct position, but that speech sound was inaudible at that time. Therefore, the listener could not hear that specific speech sound.

This study defines errors in comparison to adult forms but there is very little data about Farsi speech development in later childhood. It might be the case that these ‘errors’ are found in quite a lot of older children. Although the sample size (n=5) is very small, they could be representative of typical speech patterns in a proportion of older Farsi-speaking children.

### 9.3.1.5 Summary

Developmental phonological processes identified in the speech of the typically-developing group in this study were fronting of post-alveolar, fronting of velar, de-affrication, and lateral realisation of trill/tap. Thus several normal developmental phonological processes - reported to have disappeared between 5 and 10 years old in previous studies in the other languages - were identified, though with the possible exception of de-affrication, these processes were not pervasive. Other processes, such as stopping of alveolar and post-alveolar fricative were completely absent.

### 9.3.2 Non-cleft developmental phonological processes in the speech of Farsi-speaking children with a cleft palate

As mentioned in chapter 7, some developmental realisations which are not related to cleft palate, including some of those just discussed in 9.3.1, were identified in the speech of children with a cleft palate. These are: final consonant deletion, fronting, stopping, and lateral realisation of tap/trill.

### 9.3.2.1 Final consonant deletion

Final consonant deletion was observed in the speech of seven of the 21 children aged 5-10 with a repaired cleft palate. The targets were bilabial plosive /b/, alveolar plosives /t, d/ and alveolar tap /ɾ/. All these targets were in the final syllable of word. /b, d/ were in an utterance final position while /t, ɾ/ were within an utterance where the next word started with a vowel. Two children aged 5;1, and 5;2 could produce the target sounds /ɾ, t/ in the single word condition but they failed to do so in the sentence repetition condition. Three children aged 5;0, 5;4 and 7;8 could not produce the final consonants /b, d/ only in one position, which was the final syllable of word in the final position of utterance. As the utterance for target /d/ was the same as the one that was reported in the control group, it could be because of the length of the utterance which consisted of eight syllables.

As these children are older than 5 years, failure to articulate the final consonant might be due to production constraints: the child drops the coda because the speech sound in the final position needs more advanced planning than in the other positions (Ohala, 1992). Alternatively, it might be because of perceptual constraints, i.e. deleting the final consonant due to misperception of the adult acoustic signal. A child might not have perceived the final consonant because final consonants have less acoustic energy. Hearing problems such as mild or moderate hearing loss is one of the issues that affects the speech of children with a cleft palate (Cerom *et al.,* 2014). Therefore, this type of mispronunciation might be because of hearing loss in these children. It is persisting past normal developmental age for final consonant deletion and therefore is atypical and no longer a normal developmental pattern.

### 9.3.2.2 Fronting

As previously mentioned, fronting is a common phonological process in the speech of typically-developing children who speak Farsi and usually disappears by age 4;6 (Damirchi, 2008). Fronting of velar consonant was observed in the speech of six children aged 5;1, 5;4, 6;1, 6;3, 7;3 and 9;9 with a cleft palate. Grunwell and Harding (1995), referring to English-speaking children, proposed including non-cleft developmental realisations in the classification of cleft-type speech characteristics because a child may have a phonological disorder that is independent of, but co-existing with, speech problems arising from a cleft palate or the developmental processes may mask articulatory limitations due to cleft palate. The current study supports previous studies in English which stated that there is a greater tendency to have a persistent developmental phonological process in the children with a cleft palate compared to typically-developing children.

### 9.3.2.3 Stopping

One phonological process which was identified in the speech of children with a cleft palate was stopping. Fifteen children in the range of 5;0 to 8;1 years old showed stopping in their speech. Most of them realised an alveolar fricative /z/ as a voiced alveolar plosive [d] in the final position of the word in the sentences. According to Damirchi’s study (2008), stopping disappears around the age of 4 from the speech of typically-speaking children. As noted before, in the present study stopping did not occur in the typically-developing group. Several studies propose that a persistent stopping process may be a pattern that children with a cleft palate unconsciously use to avoid the imprecise production of fricatives (in English: Russell, 1991; Harding & Grunwell, 1996, cited in Grunwell, 1998, in Danish: Hutters & Brøndsted, 1993, in Amharic: Mekonnen, 2013 and in Arabic: Al-awaji, 2014).

Although stopping of alveolar and post-alveolar fricatives was not found in the typical group, it occurred in the speech of participants with a cleft palate. Therefore, it could be related to a cleft palate and the tendency of children with a cleft palate to use stopping as a strategy to avoid the incorrect production of these consonants.

### 9.3.2.4 Lateral realisation of trill/tap

As previously mentioned, although lateral realisation of /ɾ/ was observed in the speech of only one child in the typical group, aged 5;10, ten participants with a cleft palate (out of 21) substituted [l] for /ɾ/ in their speech. While six of them demonstrated lateral articulation and/or lateralisation for other targets which are the cleft speech characteristics, four of them showed lateral realisation only for tap/trill targets. Furthermore, five of six children who used lateral articulation/lateralisation for other targets, used lateral realisation of tap in only SIWW position. Although there is only one study that suggests lateral realisation of a tap/trill is a common realisation in the speech production of typically-developing children who speak Farsi (Fahim, 1996), there is no study that reports whether the lateral realisation of taps is related to cleft palate. There is some evidence in other languages such as Arabic (Dyson & Amayreh 2000; Ammar & Morsi, 2006; Ayyad, 2011) that this phonological process is found in typical speech development suggesting that it is not directly related to the cleft palate.

### 9.3.2.5 Summary of developmental phonological processes used by Farsi-speaking children with a cleft palate

In summary, the evidence from this study shows that normal developmental phonological processes occur more frequently in the speech of children with cleft palate in comparison to the typical group. The developmental phonological processes cited in this study are commonly observed in European languages, for example, English (Howard, 2004), Danish (Hutters, Bau, & Brond- sted, 2001), and Swedish (Karling, Larson, & Henningson, 1993). Although some of the processes are typical for their age, such as lateral realisation of a tap, some of them are not normal for their age such as fronting. Stopping, which was not found in the typical group, was added to the phonological processes in the children with a cleft palate group. These findings support several previous studies such as Chapman (1993); Peterson-Falzone et al. (2001); Konst et al. (2003) and Priester and Goorhuis-Brouwer, (2008) which suggest that the structural abnormalities which are related to cleft palate are factors that affect rate of speech development. Therefore, the normal developmental phonological processes in the speech of children with a cleft palate persist for longer in comparison with typically-developing children. In addition, some other factors which are associated with a cleft palate such as repeated hospitalisations and hearing problems due to middle ear effusion, might cause delay in their speech development.

## 9.4 Discussion summary

This chapter considered cross-linguistic similarities and differences in the context of the each research question. It has been established that there is considerable similarity between the specific cleft speech characteristics observed in the speech of Farsi-speaking children when compared with CSCs in other languages - especially English. The results also revealed some differences between Farsi and other languages that could be due to the Farsi sound system.

The typically-developing Farsi data contained some evidence of residual immaturities but none of the features were evident in the Farsi cleft speech data.

Since the typically-developing speech data did not contain any of the cleft speech characteristics it is concluded that the features found in the Farsi cleft speech data can be attributed to the history of cleft palate and its associated hearing problems. The cleft speech characteristics in GOS.SP.ASS’98 can therefore form the basis for a Farsi cleft speech assessment.

# Chapter 10 Clinical Implications and Conclusions

## 10.1 Introduction

This study has developed and piloted a Farsi version of GOS.SP.ASS’98 (Great Ormond Street Speech Assessment: Sell *et al.,* 1999). The first part of this chapter discusses its value as a tool for clinical assessment, highlighting factors that the clinician may need to be aware of when using it. More widely, the process of constructing, implementating and analysing real data from a Farsi version of GOS.SP.ASS has provided evidence that the GOS.SP.ASS protocol is an appropriate framework for the assessment of cleft speech in Farsi. However, as an additional outcome of this study some modifications to the format of GOS.SP.ASS are suggested for the Farsi version. The chapter concludes with a summary of limitations in this study, overall conclusions and suggestions for future studies.

## 10.2 Linguistic factors in the Farsi GOS.SP.ASS

The Farsi version of the speech sample developed for GOS.SP.ASS includes single words and sentences that have been based on the Farsi sound system, and they are thus specific for Farsi-speakers. Using sentence repetition as an elicitation mode was an effective way of providing information about the production of specific targets in the different syllable positions. Moreover, information about resonance is more noticeable in the sentences with low pressure consonants compared to single word (Sell *et al.,* 1999).

However, as sentence repetition is a controlled, somewhat unnatural context that needs accurate recall of sentences, it might be more difficult for children than the production of spontaneous speech. One reason is that the sentence might contain vocabulary and grammatical structures that are strange for the children, and the children cannot avoid production of these unknown words and structures in favour of familiar ones (Speake *et al.,* 2011).

A single word sample was collected from each child that targeted the same consonants as the sentence repetition material. Although single words were not used as a main data source in this study they provided a back-up data set. Howard (1993) states that using single words as an elicitation mode provides additional information about the articulatory abilities of speakers in less challenging contexts. The reason for collecting back-up data in this research study was that it was occasionally difficult to identify the features of the consonants the child was using in sentence repetition. The production of single words could help to clear this ambiguity. For example, target sound /ʒ/ in the syllable within the word /ɒʒɒ'le/ was not realised clearly in the speech of two children with a cleft palate. Therefore collected data from single words were used in this situation in order to check whether the children were in fact capable of producing the sound in a linguistic context that was less demanding than a sentence of phrase.

However, such occasions were rare and so it is suggested that in the final clinical version only sentences might be used, as in the English GOS.SP.ASS.

The process of developing a speech sample that was comparable to the English-language GOS.SP.ASS sentences revealed a number of language specific details that might have had some effect on the findings of the speech analysis and should be noted in clinical application of Farsi GOS.SP.ASS. The frequency of occurrence of various vulnerable sounds in different languages affects the speech of those with a cleft palate. Henningsson and Willadsen (2011) state that the frequency of the speech sounds plays an important role in a language. Consequently, if a language has a large number of pressure consonants in its sound system but the frequency of their occurrence is limited, a cleft palate can affect speakers less. Moreover, phonetic characteristics and the number of vulnerable consonants vary in different languages. These language-specific differences can cause one language to be more complicated and difficult than another for individuals with a cleft palate. Unfortunately the effects of the frequency of the occurrence of consonants in Farsi on the speech of children with a cleft palate cannot be described because of the lack of research in this field.

Most cleft speech characteristics that were reported in previous studies in English, were identified in the Farsi cleft speech data analysed in this study. This might be due to the phonetics of Farsi, which is fairly similar to English. For example, ejectives or pharyngeal consonants, that are parts of the sound system of other languages for which versions of GOS.SP.ASS have been developed (i.e. Arabic and Amharic) are not found in Farsi. Nevertheless, there are some differences in cleft speech features in Farsi compared with English, as discussed in Chapter 9.

## 10.3 Clinical applications of the Farsi GOS.SP.ASS

The Farsi GOS.SP.ASS incorporates a structured and replicable data set for Farsi in the same way that Sell et al. (1999) described for English. Results have shown that the assessment procedure has been shown to be sensitive to cleft speech CSCs most of which are common to both English and Farsi, although some appear to be Farsi-specific. As discussed in Chapter 9, comparison of Farsi speech analysis with CSC’s commonly found in English as listed in the UK GOS.SP.ASS CSCs revealed one language-specific cleft speech characteristic in Farsi, which is retroflex articulation. Although most cleft speech characteristics identified in the data in this study appear to be universal, when compared to studies done on European and non-European languages such as Brøndsted *et al*., (1994), Henningsson & Willadsen, (2011), Mekonnen, (2013), Al-awaji, (2014) language-specific features were also noticed in this study, as discussed in Chapter 9. Retroflex articulations were observed in the speech of four children with a cleft palate. As mentioned in chapter 7, two children substituted retroflex articulation for three different targets in their speech, while two participants used this feature in only one word position. Since this feature occurs, to varying degrees in the speech of 4/21 children in the present sample, it is suggested that this feature could be considered as one of the cleft speech characteristics in Farsi, and so should be included in the Farsi GOS.SP.ASS speech assessment.

Many studies report that irrespective of age and technique of palatal repair, approximately 50% of children with a history of cleft palate will experience speech production difficulties (Britton *et al.,* 2014). Therefore, these children are routinely referred to speech therapists, who then need to undertake an assessment of the child’s speech. To date there has been no means for SLTs in Iran to compare speech outcomes. The development of Farsi GOS.SP.ASS will therefore facilitate monitoring of individual surgeons’ caseloads, comparison between surgeons and between Farsi and other countries. This form of calibration has not been possible to date. Other reasons for accurate assessment are to establish a clear baseline before treatment in order to monitor patterns of change; to communicate effectively with colleagues; and have a robust controlled speech sample for replicability. Therefore, precise cleft speech assessment is important for the speech therapist and the individual with a cleft palate. The results of this investigation indicate that the Farsi GOS.SP.ASS can be used for this purpose when working with Farsi-speaking children. However, in the future, the protocol needs to be tested more rigorously in terms of reliability and validity, and its efficacy should also to be evaluated.

### 10.3.1 Differential diagnosis

The Farsi GOS.SP.ASS can be used to help differentiate among children with cleft palate. Passive cleft speech characteristics and hypernasal resonance may reflect structural abnormalities such as VPI or malocclusion. In this study it was possible to identify 20/21 cases whose GOS.SP.ASS analysis revealed passive cleft speech characteristics including weak nasalized consonants, nasal realisation of plosives, nasal realisation of fricatives, and gliding of fricatives/affricates. Through theoretical understanding of the implications of different passive patterns, it is possible to identify which cases with passive characteristics would benefit from referral to surgeon for a review of VP function, and which cases could be monitored by the specialist speech and language therapist throughout facial growth. The presence of only passive cleft speech characteristics in the speech of an individual with a cleft palate is an indicator that speech therapy alone will not be effective because even if the child can learn to use an accurate place of articulation, the passive cleft speech characteristic will still be present. Therefore, the best advice is medical or surgical intervention (Nagarajan *et al.,* 2009; Sweeney, 2011) and hearing check. Speech therapy might be required following surgical intervention.

Regarding ‘active’ oral and non-oral cleft speech characteristics the children change the place of articulation or the airflow direction subconsciously. Based on the type of structural abnormality, children make changes in the place of articulation. In this study oral and non-oral CSCs were observed in the speech of all 21 children with a cleft palate. For example, 16 children - in the case of VPI - change the place of oral speech sounds to a non-oral place and the result is glottal articulation, pharyngeal articulation or nasal fricative, which are all classic features of cleft palate speech. Another example is when these children use lateral articulation because of their malocclusion. All oral and non-oral cleft speech characteristics reported in English-language and Swedish studies were observed in this study including interdental articulation, lateral articulation, palatal articulation, double articulation, backing, pharyngeal articulation, glottal articulation and active nasal fricatives. The presence of only oral and non-oral CSCs in the speech of children with cleft palate are signs that speech therapy alone might be helpful.

It is important for the speech therapist to identify variability in children’s speech production, and to determine the root cause or causes of the problem (e.g. VPI, class III malocclusion, fistula, hearing difficulty). This helps in achieving an accurate differential diagnosis of an individual’s speech disorder and thus determining the ideal form and content of a treatment regime (Shriberg, 2003).

### 10.3.2 Using the Farsi GOS.SP.ASS to inform intervention

Accurate assessment and identification of cleft speech characteristics in the speech of children with a repaired cleft palate helps the speech therapist to achieve the best solution for speech intervention. Since oral and non-oral cleft speech characteristics in Farsi speakers can be identified using the Farsi GOS.SP.ASS, it would now be possible, as recommended by Kummer (2011), to identify individuals who need speech therapy intervention. Speech therapy would help them to find more accurate places of articulation.

As all 21 children with a cleft in this study use some active and passive CSCs, the Farsi GOS.SP.ASS is a useful tool for assessing which consonant realisations are determined by active processes vs. the realisations that are determined by passive processes. This will indicate to the speech therapist which consonants might benefit from speech therapy intervention vs. the ones that are only likely to improve further surgery.

As mentioned in chapter 7, glottal articulation was the non-oral cleft speech feature that was observed most frequently in this study. This type of articulation is common in other languages too. Many studies suggested that glottal articulation is one of the most challenging compensatory articulations to treat in cleft speech (e.g., Kuehn & Moller, 2000; Peterson-Falzone, *et al.,* 2001; Scherer, *et al*., 2008), especially when it becomes firmly established in the phonetic and phonological repertoire of children with a cleft palate. Therefore, it is usually recommended speech therapists try to intervene early in speech development to limit the extent of glottal pattern and prevent stabilization.

As glottal articulation is the most common misarticulation in this study, one child who used this feature for target oral phonemes is considered as an example in order to choose the best approach in speech therapy for him. M.A substituted glottals [Ɂ] and [h] for many targets /f, t, k, ɡ, x, G/. Therefore, many places of articulation have been affected, including labiodental, alveolar, velar and uvular. It should be noted that two glottal phonemes exist in the Farsi sound system i.e. /Ɂ, h/. He could produce these two glottal targets accurately in all three positions of word (SIWI, SIWW, SFWF). In this case an appropriate speech therapy intervention should aim to suppress the use of glottal realisations of oral targets, while retaining the glottal phonemes that are used in Farsi. One recommended approach for the type of problem is a multiple-opposition intervention approach (Williams, 2000). This is similar to a minimal pairs approach. The difference is that the multiple-opposition approach has a greater focus on several target sounds together as a group. This approach could be appropriate for children such as M.A with a limited number of speech sounds in all word positions.

At the time of planning an effective speech therapy intervention, the Farsi GOS.SP.ASS data would facilitate identification of the affected sound classes. The most affected consonants in this study were alveolar /z, d/ and post-alveolar /ʒ/ - sounds that have alveolar and post-alveolar places of articulation. These affected speech sounds could be predicted by previous studies in other languages. Speech therapy could be focused on the sound class of alveolar and/or post alveolar, rather than on individual consonants.

### 10.3.3 Identification of clinically relevant variability using the Farsi GOS.SP.ASS

Inter-speaker variability was observed in this study, as reported in Chapter 8. This is common in the speech of individuals with a cleft palate (e.g., in English: Kuehn & Moller, 2000; Howard, 2012; in Swedish: Klintö *et al.,* 2011). The participants used varied cleft patterns as well as non-cleft patterns. Moreover, they were different in their use of cleft speech characteristics. These variations between the participants show that they produce different sounds when there are articulatory and perceptual constraints associated with cleft palate (Broen *et al.,* 1993; Howard, 1993; Harding & Howard, 2011). Phonetic and phonological differences in their speech might therefore be because of the effects of the specific compensatory strategies that they used in their speech.

However, phonological difficulties unrelated to cleft palate might also appear in the speech of children with a cleft palate. Many studies suggest that atypical speech production due to structural abnormalities can lead to phonological difficulties (Bzoch, 1997; Chapman, 1993; Russell & Grunwell, 1993; Harding & Grunwell, 1996; Harding-Bell & Howard, 2011). Therefore, it is vital to know about phonological perspectives at the time of encountering production of cleft speech characteristics, because phonological approaches provide different reasons and ways of intervention for atypical speech production.

The age of children in this study is between five and ten years. Therefore, only a few typical developmental phonological realisations in Farsi would be expected, such as lateral realisation of trill/tap. However, most children in this study showed some typical developmental phonological processes in addition to cleft speech characteristics. Identifying these typical types of processes in the speech of children with a cleft palate is important for speech therapists because they can design the best intervention plan for the child with a cleft palate. They can find these processes and compare them with cleft speech characteristics and other developmental speech difficulties (Grunwell, 1982; Miccio & Scarpino, 2008). It is important that the speech therapist considers phonetic and phonological differences in the speech of different children with a cleft palate, and finds the main reason or reasons for the problem such as: VPI, class Ⅲ malocclusion, fistulae and hearing problems. Shriberg (2003) stated that when the speech therapist obtains a particular diagnosis of speech disorder for different individuals, this helps to identify the best type and content of intervention.

It is suggested that if the speech variability is not due to typical developmental processes, it might be as a result of structural abnormalities related to cleft palate with or without additional phonological development difficulties (Harding & Grunwell, 1996; Harding & Howard, 2011) or associated hearing loss during speech acquisition (Kummer, 2011). For example, in the Farsi data /z/ is affected by interdental articulation, palatal articulation, backing, pharyngeal articulation, glottal articulation, active nasal fricative, weak nasalized articulation, nasal realisation of fricative, gliding of fricative. In a clinical context, oral examination and instrumental investigation and hearing assessment would help to determine whether a particular child’s substitutions could be directly attributed to structural abnormalities associated with the cleft palate, to hearing loss or to developmental phonological difficulties.

Analysis of the Farsi speech data facilitated identification of possible contributing factors and co-existing conditions. Maintaining the distinction between CSCs and non-cleft developmental patterns in this study facilitated the identification of aspects of speech that were not cleft related and might benefit from other management. For example, the lateral realisation of the target tap/trill in the current study was observed in the speech of four children. As lateral articulation/lateralisation as a cleft speech characteristic was not seen in their realisation of any other consonants, this type of articulation is most likely related to typical phonological development in Farsi. It is suggested that this pattern need not therefore be a priority in intervention because this is age appropriate. This pattern was found in the speech of typically-developing children who are the same age as the cleft group in this study.

### 10.3.4 Factors affecting take-up of speech therapy in Iran

Although all the children in the cleft group had had palatal surgery several years before their speech was assessed for this study, most of them still showed residual speech difficulties which are related to cleft palate. As suggested in the previous section, use of the Farsi GOS.SP.ASS may help in more accurate assessment of the child’s speech difficulties as a basis for effective intervention. Speech therapy sessions are likely to be beneficial for such children, on the assumption that they attend regularly (Smith & Guyette, 2004; Persson *et al*., 2006). However, in Iran attending speech therapy sessions on a regular basis is not easy for children who live far from the capital city. Additionally, there are not enough hospitals that provide speech therapy services and professional team for individuals with a cleft palate, especially in the smaller and more remote regions.

A related factor that affects the process of speech therapy intervention for children with a repaired cleft palate is the attitude of family and the extent to which the parents engage with therapy advice. Use of the Farsi GOS.SP.ASS would therefore need to be supplemented by explanations to the parents about the importance of attending speech therapy sessions regularly and the gradual nature of acquisition of new sounds, especially after the palatal repair. Additionally, it is helpful to explain the benefits of home-based practice and the effects of the contribution by the speech therapist to the parents in order to minimize the impact of the cleft palate and hearing difficulties on later speech development. Sell et al. (2011) stated that there might be considerable cultural differences affecting the attitude of parents and their fears and hopes regarding speech therapy intervention.

## 10.4 Limitations of the study

As previously mentioned, the design, development and trial of a Farsi version of GOS.SP.ASS’98 were among the main purposes of this study. Some limitations appeared during this research. This section reviews firstly, the methodological issues which are associated with the speech elicitation materials. Secondly, different limitations in general are discussed.

### 10.4.1 Methodological issues

Sentence repetition was used as an elicitation mode in this study. The speech sample for this study was based on Sell et al.’s (1999) rationale for the construction and design of the GOS.SP.ASS elicitation material to achieve the best information about the speech of individuals with a cleft palate, but some challenges were observed which were related to the Farsi sound system and its specific phonological constraints. For example, some target sounds specially /d/ were not audible to the listener in the final position of the word in utterance final position. Another challenge was the length of the sentences. Making short sentences was attempted, but considering the phonotactic features and grammatical complications of Farsi, some sentences had to be replaced with phrases. Although phrases were shorter than sentences, sometimes they were unfamiliar for the children because of the grammatical structure compared to sentence.

Another difference which is seen in Farsi is that Farsi has many multisyllabic words which may make pronunciation of pressure consonants more difficult than other languages which have more monosyllables. It also meant the sentence length had to be modified.

Controlling the phonetic context to include only the target consonant in each sentence with vowels and approximants was challenging. An attempt was made to reflect this criterion but because Farsi has certain constraints that make the task difficult, designing the sentences with only target sounds was difficult.

Regarding the method of speech analysis employed in this study, transcribing and analysing speech production has been essential to theoretically-principled interpretation of the speech data. Although using perceptual analysis is known as a ‘’gold standard’’ method to analyse cleft speech (Sell, 2005), using perceptual assessment only is another limitation. It was limited by the lack of other Farsi-speaking SLTs with experience in transcribing cleft palate speech. As mentioned in chapter 3, inter-rater reliability is problematic in this type of analysis. Although a training program was developed and sent to the second listener, it was not possible to arrange face-to-face training, so listening was carried out independently. In addition, for practical reasons the inter-rater reliability sample had to be kept relatively small. Nevertheless, the results of transcription agreement have met the basic standard set in the literature and for resonance and airflow agreements, both transcribers agreed completely for the entire set of items, including hypernasality, hyponasality, nasal emission and nasal turbulence. Another methodological issue in this study was the lack of validity reporting. This drawback is often found in the early stages of GOS.SP.ASS-based research-though in English-language studies this has been addressed at later satages in the research programme. A comparison of data from the single word and sentence repetition tests is one way in which the tool could be validated.

Perceptual transcriptions of speech have limitations particularly in deciding precise place of oral articulation. Ideally a research project would have included instrumental analysis. It is clearly helpful to investigate and provide more information on place of articulation of consonants. As instrumental equipment such as EPG or UTI were not available in the speech therapy clinic where the data was collected, it was not possible to obtain any information of this kind. It is suggested that future validation of Farsi GOS.SP.ASS could include ultrasound scanning for oral misarticulations which would be a benefit to clinical management and to research about cleft palate speech.

### 10.4.2 General limitations

The practical limitations of carrying out research in two different countries with a limited time window for data collection restricted the participant selection process.

The sample size was necessarily limited, particulary with regard to the non-cleft comparative group (n= 5). While in theory it would have been possible to have a control group that was the same size as the cleft group, because of time limitations this would have meant reducing the size of the cleft group. It was therefore decided to have unequal sized groups with a larger cleft group, as this would enable more comprehensive identification of cleft speech features, in line with the main aim of the study.

It was not possible in Chapter 8 to create sub-groups based on cleft-type classification, or age of palate repair because the number of children in each cleft group was not similar and the overall group size was too small. As mentioned in chapter 8, with a study based on 21 participants with a cleft palate, it was not possible to use statistical analysis to explore in more detail the relationship between accurate speech production and the two variables of age at the time of assessment, and type of cleft palate. .

The grouping of children into preschool/school, based on the concept of persisting speech difficulties, is a little problematic given that these children have an identifiable cause for their speech errors (different to children with speech difficulties of unknown origin). Furthermore, the range of other factors that might act as variables (age of surgical repair, amount or SLP intervention) make it difficult to isolate the effect of age alone.

A further limitation is that the lack of Farsi studies on cleft speech and also on typically-developing speech, made it difficult to compare the findings of this study with previous studies. In addition, some information was not available that would give a more complete picture of the children, for instance type of surgery, dental and occlusion status, or history of speech therapy intervention. For example, having information about the amount of speech therapy attendances would have been useful to identify any relationship between accuracy of speech and the amount of intervention to date. Similarly it would have been helpful to have access to detailed information about surgical history, hearing management and social environment from birth. Although information was not directly relevant to the research questions addressed in this study, it would have been interesting to have had access to it.

## 10.5 Suggestions for future studies

Speech development in children with a cleft palate is affected by a large number of variables and many of these variables are similar to those which affect the speech of typically-developing children. However, there are few studies on speech development in typically-developing children who speak Farsi. Therefore, a longitudinal study of the speech development of typically-developing Farsi-speaking children is needed, especially for the purpose of clinical comparison.

Using a longitudinal design in studies of speech development in children with a cleft palate such as Lohmander & Persson (2008)’s study in Swedish is also useful. This may help to examine the effects of early surgery and speech intervention in the speech production of children with a cleft palate. In future studies, it would be interesting to consider cleft speech characteristics in the context of the child’s history and the therapy they might have had before.

A cross-sectional study with a larger sample size could be conducted to investigate the relationship between speech outcome and different variables such as age at the time of assessment and cleft-type, or age at the repair and cleft-type in the children with a cleft palate who speak Farsi.

Occurrences of some of the speech processes such as dentalisation or lateralisation in this study could be identified as typical speech development characteristics, as a result of structural abnormalities associated with cleft palate, or other difficulties such as hearing impairment (Eurocleft study, 1993; Hutters *et al.,* 2001). It is suggested for future studies that managing an oral motor examination, and reviewing the patient’s medical notes besides phonetic and phonological analysis would be valuable to help find out the root cause of occurrences of these types of features in the speech of children with a cleft palate.

In conclusion, this study has developed our knowledge about the speech production, primarily the consonant production of children with a cleft palate who speak Farsi. In addition to establishing whether or not the English GOS.SP.ASS could be adapted for use with Farsi-speaking children, this final chapter has illustrated further clinical potential for interpreting speech findings from the Farsi GOS.SP.ASS diagnostically.

## 10.6 Conclusion

The main aim of this study was to identify and describe speech features that are likely to be related to a cleft palate, or not related to a cleft palate, in the speech of Farsi-speaking children with a repaired cleft palate. Assessment of 21 children using a version of GOS.SP.ASS’98 showed the extent to which the range of speech characteristics in Farsi-speaking children matched the features reported in other languages. Details of the precise nature of these speech characteristics have been presented and explained in chapters 7, 8 and 9.

The results demonstrated that speech features of Farsi-speaking children with a repaired cleft palate closely match the speech features reported in other languages but some specific differences have been noted. Some characteristics seem to occur as a result of the specific structure and systemic properties of a particular language e.g. the retroflex articulation for /s, z, t, d, l, ɾ/ targets in the speech of Farsi-speaking children with a repaired cleft palate. In addition, the results indicate that some previously reported cleft speech characteristics have not been identified in this study, such as backing to uvular and absent pressure consonant. Backing to uvular may be very rare in all languages as it has not been reported in recent studies in English. Absent pressure consonants is a characteristics which is usually associated with marked VPD which would usually have been treated with secondary surgery when children are younger that the age group in this study.

Based on this rationale the category absent pressure consonants would be retained in a Farsi GOS.SP.ASS but backing to uvular might be omitted.

Speech production in Farsi-speaking children in relation to age at the time of assessment and type of cleft palate was an additional research point in this study. Regarding age, this study indicated that there was no remarkable relationship between the occurrence of any particular cleft speech characteristic in the speech of Farsi-speaking children with a repaired cleft palate and their age. This result is in contrast with some earlier studies that suggested that the number of cleft speech characteristics decreases when the age of child increases (Lohmander *et al.,* 2011). An age effect might have been more apparent if the younger group of children had been under the age of four years. Furthermore, in terms of the type of cleft, there was no very clear difference between the groups. However, there are suggestions of some differences. This suggested differences relates to what has been reported in the literature already. However, the sample size in this study is small and therefore no firm conclusion can be drawn with regard to this particular issue.

This study provides an evidence base for adopting a modified version of the English GOS.SP.ASS for use with Farsi-speaking children. Before making it widely available to clinicians, it would be useful to make some further modifications in the light of the results of this study. Firstly, retroflex articulation will be added to the CSCs category as a posterior oral cleft speech characteristic. Secondly, the clinical version of the Farsi GOS.SP.ASS can be based on sentences only (i.e. omitting the single word sample) . Finally, improvements could be made to some of the elicitation sentences in terms of length or syllable structure. However, it has not been possible to undertake a full revision of the material within the time scale of this study.

On the basis of this study, the Farsi version of GOS.SP.ASS can be recommended as a clinical assessment protocol for speech and language therapists (SLTs) in Iran to assess cleft speech. These SLTs would not be specialists and therefore would need some training. A training programme based on the CAPS-A training model could also provide a context for testing and evaluating the Farsi GOS.SP.ASS in terms of validity, reliability and sufficiency.

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# Appendices

**Appendix 1: An overview of studies on phoneme acquisition adapted from Dodd *et al*. (2003:619-20)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Wellman *et al.* ([1931](#_ENREF_64)) | Poole ([1934](#_ENREF_37)) | Templin ([1957](#_ENREF_53)) | Olmsted ([1971](#_ENREF_33)) | Prather ([1975](#_ENREF_38)) | Smit *et al.* ([1990](#_ENREF_47)) |
| Subject no. | 204 | 65 | 480 | 100 | 147 | 997 |
| Age range | 2;0-6;0 | 2;6-8;6 | 3;0-8;0 | 1;3-4;6 | 2;0-4;0 | 3;0-9;0 |
| Area | Iowa | Michigan | N/A | N/A | Seattle | Iowa/Nebraska |
| Speech model | S and I | S and I | S and I | S | S | S |
| Word-position | I, M, F | I, M, F | I, M, F | I, M, F | I, F | I, F |
| % age group | 75% | 100% | 75% | 50% | 75% | N/A |
| Acquired first | m, n, b, f, w, h | m, p, b, w, h | m, n, ŋ, p, f, w, b | - | m, n, ŋ, p, h | m, n, p, b, d, w |
| Acquired last | ŋ, θ, ð, ʒ, dʒ | θ, z, ʒ, dʒ | ð, z, ʒ, dʒ | ŋ, ð, ʒ, ʧ, dʒ | v, θ, z, dʒ | ŋ, s, z, ɹ |
| m | 3 | 3;6 | 3 | <4 | 2 | 3 |
| n | 3 | 4;6 | 3 | <4 | 2 | 3;6 f, 3m |
| p | 4 | 3;6 | 3 | <4 | 2 | 3 |
| b | 3 | 3;6 | 4 | <4 | 2;8 | 3 |
| t | 5 | 4;6 | 6 | <4 I, F; >4 M | 2;8 | 4;6f, 3;6m |
| d | 5 | 4;6 | 4 | <4 | 2;4 | 3f, 3;6m |
| k | 4 | 4;6 | 4 | <4 | 2;4 | 3;6 |
| ɡ | 4 | 4;6 | 4 | <4 | 3 | 3;6f, 4m |
| f | 3 | 5;6 | 3 | <4 | 2;4 | I: 3;6, F: 5;6 |
| v | 5 | 6;6 | 6 | <4 | >4 | 5;6 |
| Θ | >6 | 7;6 | 6 | <4 M, F; >4 I | >4 | 6f, 8m |
| d | 6 | 6;6 | 7 | >4 | 4 | 4;6f, 7m |
| s | 5 | 7;6 | 4;6 | <4 | 3 | 7-9 |
| z | 5 | 7;6 | 7 | <4 M, F; >4 I | >4 | 7-9 |
| ʃ | No info. | 6;6 | 4;6 | <4 | 3;8 | 6f. 7m |
| ʒ | 6 | 6;6 | 7 | >4 | 4 | No info. |
| ʧ | 5 | No info. | 4;6 | <4 F; >4 I, M | 3;8 | 6f, 7m |
| dʒ | 6 | No info. | 7 | <4 F; >4 I, M | >4 | 6f, 7m |
| l | 4 | 6;6 | 6 | <4 F; >4 M, F | 3;4 | I:5f, 6m; F:6f, 7m |
| ɹ | 5 | 7;6 | 4 | <4 | 3;4 | 8 |
| w | 3 | 3;6 | 3 | <4 | 2;8 | 3 |
| j | 4 | 4;6 | 3;6 | No info. | 2;4 | 4f, 5m |
| h | 3 | 3;6 | 3 | No info. | 2 | No info |
| Notes:   1. For the row word position, I, M and F refers to word-initial, -medial and -final positions. 2. % age group refers to the minimum percentage of children of an age group required in deciding the acquisition of phoneme. 3. In the Speech mode row, S and I refer to spontaneous production or imitation. 4. In the results section, Olmstead (1971) and Smit *et al* (1990) list different age of acquisition for some of the phonemes at different word positions. Smit *et al* also list different age of acquisition for some of the phonemes by girls (indicated by f) and boys (indicated by m). 5. The number of sounds listed for the rows ‘sounds acquired first’ and ‘sounds acquired last’ is limited to about 5 sounds. | | | | | | |

**Appendix 2: Examples of information sheets and consent forms used for participant recruitment**



Research Project Information Sheet

(To be translated into Farsi)

**A Speech Production comparison between Farsi-speaking Children with Cleft Palate and Children without Abnormality in their Palate**

**Mrs. Baharak Baranian**

**Professor Bill Wells**

**Dr. Anne Harding-Bell**

Department of Human Communication Sciences

University of Sheffield

This information sheet has been provided for you in order to help you to decide whether to allow your child to participate in this study or not. Please read this information sheet carefully and discuss it with other speech and language therapists if you wish. If you decide to allow your child to participate in my study, I will be pleased to answer any questions that you may have and I will explain the consent form to you.

Thank you for taking your time to read this information sheet.

**The Research Team**

My name is Baharak Baranian. I am a PhD student at the Department of Human Communication Sciences, The University of Sheffield, UK. My supervisors, Professor Bill Wells and Dr. Anne Harding-Bell both, work in the Department of Human Communication Sciences, at The University of Sheffield. They supervise and carry out research on communication impairments such as speech in children with cleft palate.

## The objective of the study

The aim of this project is to describe the speech production of Farsi-speaking children who have cleft palate, and also to compare their speech production with the speech of Farsi-speaking children of similar age who do not suffer from cleft palate. Studies on other languages have shown that cleft lip and/or palate often affects speech production, but currently there are no studies on cleft palate speech in Farsi. Following this, I will improve the assessment and other procedures for speech and language therapists working with children who have cleft palate. This project will be done in three years and the results of this project will be useful for developing speech assessments of cleft palate children.

I intend to do this project by making audio and video recordings of your child’s speech and I will then listen to the recordings and make detailed phonetic transcriptions of the speech (writing down how the children are producing sounds using a special symbol system). From this information, I will investigate whether the speech production of your child with cleft palate is different from typical speech and look at the ways in which it differs. A deeper understanding about how cleft palate affects speech production in children may help speech therapists ***to improve services for children with cleft palate.***

## Why my child has been chosen?

Your child has been invited to participate in this project with me, because

* She/he attended in the speech therapy clinic, University of Tehran.
* Farsi is her/his first language.
* She/he has a cleft palate.
* ***His/her age is between 5-10 years old;***

## Is it compulsory to take part in this project?

You have a right to decide about your child’s participation in this project. If you agree to participation, you will be given this information sheet to take home and ask to sign a consent form. You can withdraw from the project at any time without any reason and this will not affect your child’s speech therapy in any way. At this point, I will destroy the copies of your child’s speech recordings.

## What will happen if my child participates in the project?

If you agree to your child’s participation, I will invite you and your child to come for an appointment at the speech therapy clinic in the university. It will last approximately for half an hour. During the appointment, I will do some tests and record your child speech production ***using audio and video recorders***. A variety of speech tasks such as producing single words and short sentences will be assessed. I will use these recordings to establish features of speech production in children with cleft palate in single words production and connected speech.

## What are the potential disadvantages and risk of taking part in the project?

I do not envisage any particular risks or disadvantages to your child. ***We will need you to be available to come for one session to the Speech therapy clinic for recording session, with the date and time arranged with you to ensure this is convenient. The session will normally last for half an hour.***

## What are the benefits of participating?

I cannot promise that the study will help your child, but the information that we obtain from the study may help Farsi-speaking children with cleft palate in future.

## Will my child be identified in any way through taking part in this research?

The video will contain footage of your child saying some words and sentences and will not be edited to make your child’s face anonymous. ***Audio recordings will be anonymous, however***. Only the supervisors and I and you will have access to the video ***and audio data.*** You will be specifically asked whether you consent to the video being shown ***and audio data being heard*** for any additional reasons such as a scientific presentation or teaching purposes. You do not have to agree to this if you wish your child to participate in this study. If you agree you will be asked to view the video ***and/or listen to audio data***, before they are used to check whether you are happy for me to use them. I will ask you to sign a consent form for the video ***and audio recordings*** to be used for any additional purpose when and where necessary. ***You are free to refuse to give this extra consent. If so, when the recordings are no longer being used for this project, they will be destroyed.***

Copies of speech recording from your child will be kept securely in a locked cabinet in the researcher office in the University of Tehran, Department of Speech Therapy and also in the University of Sheffield, Department of Human Communication Sciences. The following people may have an access to the recordings:

My supervisors: Professor Bill Wells

Dr. Anne Harding-bell

The researcher: Baharak Baranian

Your child’s speech data will be given a code number for the project and no information about you or your child (e.g. names, addresses, date of birth, telephone numbers, etc) will be kept with the recordings. The speech recordings will be stored for the duration of the study, which is due to run until September 2014.

## What will happen to the result of the project?

The results will form part of my PhD research and may be published in scientific journals or presented at research conferences. The results may also be presented to local groups and organisations supporting children with speech difficulties. The research data collected can possibly be used for future research, as part of scientific presentations, or teaching purposes. You will be specifically asked whether you wish the data to be used for other purposes. You will not have to agree to this and if you are happy for me to use the data in this way you will be asked to sign your consent form for data to be used for these additional purposes.

**What if there is a problem or I wish to make a complaint?**

If you have any concerns feel free to discuss these with the researcher, Baharak Baranian (me) (+989122081829; in Iran and +447846090302; in UK) or my supervisors Professor Bill Wells (+44 (0) 114 222 2429; email: bill.wells@sheffield.ac.uk) or Dr. Anne Harding-Bell (+44 (0) 114 222 2436; email: a.harding-bell@sheffield.ac.uk) or your child’s current speech and language therapist at the university clinic. If you wish to discuss concerns with someone unrelated to the project you can contact Professor Shelagh Brumfitt, who is the Head of the Department of Human Communication Sciences, University of Sheffield, (+44 (0) 114 222 2418; email: s.m.brumfitt@sheffield.ac.uk). If you are not satisfied that your concerns have been dealt with satisfactorily by the people above, you can complain formally to the Registrar and Secretary of the University of Sheffield, Western Bank, Sheffield, S10 2TN.

**Who has reviewed this project to ensure that it is of a suitable research standard and that it meets ethical requirements?**

This project has been reviewed by the **Department of Human Communication Sciences Research Ethics Review Panel, University of Sheffield.**

**Contacts for further information**

For further information or comments, you can contact the researcher

Baharak Baranian

Department of Human Communication Sciences

University of Sheffield

31 Claremont Crescent

Sheffield

S10 2TA

Tel: +989122081829 (in Iran) +447846090302 (in UK)

Email: bbaranian1@sheffield.ac.uk

**Participant Consent Form**

|  |
| --- |
| **Title of Project:** A Speech Production Comparison between Farsi-speaking Children with Cleft Palate and Children without Abnormality in their Palate  **Name of Researcher:** Baharak Baranian  **Please initial box**   1. I confirm that I have read and understand the information sheet dated ( ) for   the above project and have had the opportunity to ask questions.   1. I understand that my child participation is voluntary and that we are free to withdraw at any time without giving any reason. 2. I understand that my child’s responses will be anonymised before analysis 3. I give permission for members of the research team to have access to these anonymised responses. 4. I agree for my child to take part in the above research project.   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Name of Participant Date Signature  (*or legal representative*)  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Name of person taking consent Date Signature  (*if different from lead researcher*)  *To be signed and dated in presence of the participant*  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Lead Researcher Date Signature  *To be signed and dated in presence of the participant*  Copies:  *Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/pre-written script/information sheet and any other written information provided to the participants. A copy for the signed and dated consent form should be placed in the project’s main record (e.g. a site file), which must be kept in a secure location.* |

**Appendix 3: Great Ormond Street Speech Assessment ’98- Farsi Version GOS.SP.ASS ’98**

|  |
| --- |
| Name: Date: |
| Age: Patient No. |
| Gender: Recording/Tape No. |
| Type of cleft: First language: |
| Contact Person: Address: |

**Resonance**

Hypernasality 0--1--2--3 □ consistent □ inconsistent

Hyponasality 0--1--2

Cul-de-sac-resonance □ present □ absent

Mixed resonance □ present □ absent

**Nasal Emission** 0--1--2 □ audible  and/or □ inaudible

□ accompanying and/or □ replacing consonants

**Nasal Turbulence** 0--1--2

□ accompanying and/or □ replacing consonants

□ consistent □ inconsistent

**Grimace** 0--1--2--3

□ consistent □ inconsistent

|  |  |  |
| --- | --- | --- |
| **Mirror test** | | |
|  | **Right** | **Left** |
| **pa pa** |  |  |
| **pi pi** |  |  |
| **ka ka** |  |  |
| **ki ki** |  |  |
| **Ssss** |  |  |

**Consonant production**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Labial | | | | | Alveolar | | | | | | | Post-alveolar | | | | Palatal | Velar | | | Uvular | Glottal | |
|  | m | p | b | f | v | n | t | d | s | z | ɾ | l | tʃ | dʒ | ʃ | ʒ | j | k | ɡ | x | ɢ | ʔ | h |
| SIWI |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SIWW |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SFWF |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Cleft Speech characteristics (CSCs)**

|  |  |
| --- | --- |
| **Anterior oral CSCs**   □ Linguolabial articulation  □ Dentalisation/Dental articulation  □ Interdental articulation/Interdentalisation  □ Lateralisation/Lateral articulation  □ Palatalisation/Palatal  articulation  □ Double articulation | **Non-oral CSCs**  □ Pharyngeal articulation  □ Glottal articulation  □ Active nasal fricative |
| **Posterior CSCs**    □ Backing to velar   □ Backing to uvular | **Passive CSCs**  □ Weak and/or nasalised articulation  □ Nasal realisation of fricatives  □ Nasal realisation of plosives  □ Gliding of ficatives/affricates |



**Developmental realisations**

**Summary of speech pattern**

0 Normal consonants 0-1 No CSCs 1 Anterior oral CSCs 2 Posterior oral CSCs 3 Non-oral CSCs 4 Passive CSCs 5 Developmental errors 6 Other

**Speech and language therapy**

□ Unnecessary □ Waiting list □ Therapy ongoing □Regular review □Unavailable □ No uptake

**Location** □ Specialist □ Community

**Relevant information from parents:**

**Voice** □ Normal □ Dysphonic

**Visual appearance of speech**

 □ Unremarkable □ Tight upper lip □ Tongue tip appearing □ Asymmetry of facial movement

**Oral examination**

1. **Nose** □ Unremarkable □ Deviated septum □ Obstructed
2. **Lips** □ Unremarkable  □ Restricted movement □ Open mouth posture
3. **Occlusion** □ Class I □ Class II □ Class III □ Anterior open bite
4. **Dentition**  □ Unremarkable □ Supernumerary □ Missing teeth □ Malaligned
5. **Tongue** □ Unremarkable □ Poor mobility □ Abnormal posture  □ Tongue tie
6. **Palatal Fistula** □ Present □ Absent
7. **Fistula Size** □ Minute < than 2 mm  □ Small between 2-5 mm □ Medium between 5-8 mm  □ Large >8 mm □ Complete breakdown
8. **Fistula Location**  □ Uvula □ Soft palate □ Junction soft/hard palate   □ Hard palate-post alveolus  □ Buccal sulcus □ Other (describe) □ Hard palate and buccal sulcus
9. **Palate Mobility** □ Marked  □ Moderate □ Slight □ None
10. **S.P.** □ Bifid uvula □ Notch □ Blue/thin looking  □ Suspected incorrect muscle alignment □ Apparently short
11. **Nasopharynx**

□ Tonsils

□ Apparently deep pharynx

 □ Pharyngeal wall movement

□ Pharyngeal flap

**Language** □Apparently normal □ Delayed □ Disordered

**Identifiable aetiology**

□ Suspected VPI □ Confirmed VPI □ Abnormal dentition □Malocclusion   □ Diagnosed hearing loss □ Suspected hearing loss □ Oral fistula □ Cleft palate history □ Intellectual deficit  □ Developmental □ Environmental □ Syndrome

**Areas requiring further assessment**



**Management plan**



**Additional notes**

**Speech and language therapist**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Signature**

**Appendix 4: Farsi GOS.SP.ASS sentences and single words**

|  |  |  |  |
| --- | --- | --- | --- |
| **Phonetic Symbole** | **Phonetic Transcription** | **English** | **Farsi** |
| /b/ | /ˈbɒl/ | Wing | بال |
| /p/ | /'pɒ/ | Foot | پا |
| /t/ | /'tup/ | Ball | توپ |
| /d/ | /'dær/ | Door | در |
| /s/ | /si'ni/ | Tray | سيني |
| /z/ | /'zæn/ | Lady | زن |
| /tʃ/ | /'tʃub/ | Wood | چوب |
| /g/ | /'guʃ/ | Ear | گوش |
| /k/ | /'kuh/ | Mountain | كوه |
| /ʤ/ | /'ʤib/ | Pocket | جيب |
| /G/ | /'Gɒz/ | Duck | غاز |
| /r/ | /ru'bɒh/ | Fox | روباه |
| /ʃ/ | /'ʃir/ | Lion | شير |
| /x/ | /'xɒl/ | Spot | خال |
| /ʒ/ | /ʒɒ'ket/ | Jacket | ژاكت |
| /v/ | /vɒ'net/ | Van | وانت |
| /f/ | /'fil/ | Elephant | فيل |
| /h/ | /ho'lu/ | Peach | هلو |
| /m/ | /mɒ'hi/ | Fish | ماهي |
| /n/ | /'nun/ | Bread | نون |
| /l/ | /li'vɒn/ | Glass | ليوان |
| /j/ | /'jɒs/ | Jasmin | ياس |
| /ʔ/ | /ʔej'næk/ | Glasses | عينك |

Medial position

|  |  |  |  |
| --- | --- | --- | --- |
| **Phonetic Symbole** | **Phonetic Transcription** | **English** | **Farsi** |
| /b/ | /gor'be/ | Cat | گربه |
| /p/ | /tʃu'pɒn/ | Rancher, Pastor | چوپان |
| /t/ | /ke'tɒb/ | Book | كتاب |
| /d/ | /tʃɒ'dor | Scarf | چادر |
| /s/ | /ʔæ'sæl/ | Honey | عسل |
| /z/ | /Gæ'zɒ/ | Food | غذا |
| /tʃ/ | /Gej'tʃi/ | Scissors | قيچي |
| /g/ | /si'gɒr/ | Cigarette | سيگار |
| /k/ | /pɒ'kæt/ | Envelope | پاكت |
| /ʤ/ | /ʔɒ'ʤil/ | Nut | اجيل |
| /G/ | /kɒ'Gæz/ | Paper | كاغذ |
| /r/ | /ʤu'rɒb/ | Socks | جوراب |
| /ʃ/ | /mɒ'ʃin/ | Car | ماشين |
| /x/ | /no'xod/ | Peas | نخود |
| /ʒ/ | /mɒ'ʒik/ | Marker | ماژيك |
| /v/ | /di'vɒr/ | Wall | ديوار |
| /f/ | /tele'fon/ | Telephone | تلفن |
| /h/ | /ʔɒ'hu/ | Deer | اهو |
| /m/ | /næ'mæk/ | Salt | نمك |
| /n/ | /ʔæ'nɒr/ | Pomegranate | انار |
| /l/ | /ke'lid/ | Key | كليد |
| /j/ | /dær'jɒ/ | Sea | دريا |
| /ʔ/ | /sɒ'ʔæt/ | Watch | ساعت |

Final position

|  |  |  |  |
| --- | --- | --- | --- |
| **Phonetic Symbole** | **Phonetic Transcription** | **English** | **Farsi** |
| /b/ | /'tɒb/ | Swing | تاب |
| /p/ | /'sup/ | Soup | سوپ |
| /t/ | /'kot/ | Coat | كت |
| /d/ | /ko'mod/ | Wardrobe | كمد |
| /s/ | /ʔæ'rus/ | Bride | عروس |
| /z/ | /'gɒz/ | Oven | گاز |
| /tʃ/ | /'pitʃ/ | Screw | پيچ |
| /ɟ/ | /'sæɟ/ | Dog | سگ |
| /ҫ/ | /'xuҫ/ | Pig | خوك |
| /ʤ/ | /'kɒʤ/ | Pine tree | كاج |
| /G/ | /'buG/ | Horn | بوق |
| /r/ | /'mɒr/ | Snake | مار |
| /ʃ/ | /'muʃ/ | Mouse | موش |
| /x/ | /'yæx/ | Ice | يخ |
| /ʒ/ | /gɒ'rɒʒ/ | Garage | گاراژ |
| /v/ | /'gɒv/ | Cow | گاو |
| /f/ | /'kif/ | Bag | كيف |
| /h/ | /'dæh/ | Ten | ده |
| /m/ | /'dom/ | Tail | دم |
| /n/ | /dɒ'mæn/ | Skirt | دامن |
| /l/ | /'gol/ | Flower | گل |
| /j/ | /'tʃɒj/ | Tea | چاي |
| /ʔ/ |  |  |  |

Appendix 5:

Target Sentence English meaning Syllables

/b/ gorbe'je 'bæd ru'je 'tɒb A bad cat on the swing (7)

/p/ tʃu'pɒne 'pir 'sup ʔɒvor'de An old shepherd has brought a soup (8)

/t/ tu'po ketɒ'bet ɒbijæn Your ball and book are blue (8)

/d/ tʃɒ'dor ru 'dære ko'mod The scraf on the wardrobe’s door (7)

/s/ se 'tɒ ʔæ'rus ʔæ'sæl xor'dæn Three brides ate honey (8)

/z/ 'zæn bɒ 'gɒz 'ʔɒʃ mipæ'ze The lady cooks food by oven (7)

/tʃ/ bæ'tʃe 'bɒ tʃu'bo 'pitʃ The baby with a wood and screw (6)

/g/ je mæ'gæs 'ru gu'ʃe 'sæɟ A Fly on the dog’s ear (7)

/k/ je pɒkæt tu ki'fe 'xuҫ An envelope is in the pig’s bag (7)

/ʤ/ mæ'ʤid 'bɒ ʤi'be 'kæʤ Majid with a messy pocket (6)

/G/ Gɒz 'tʃɒ'Ge ɒ'jeG ʃo'de A Fat goose has hidden (7)

/r/ 'mɒr ʔæz su'rɒx ræf'te A snake went from the whole (6)

/ʃ/ 'ʃæb 'muʃ u'mæd tu mɒ'ʃin A mouse came to the car during the night (7)

/x/ xɒ'le 'bɒ 'jæx mixo're My aunt is eating ice with soup (8)

/ʒ/ ʒɒke'te ɒʒɒ'le ru ʃu'fɒʒ Jale’s jacket is on the heater (8)

/v/ 'bɒ vɒ'net 'gɒv ʔɒvor'dæn They brought a cow by the van (7)

/f/ fi'le se'fid 'bɒ 'kif u'mæd The white elephant came with a bag (8)

/h/ 'dæh ɒ'hu ho'lu xor'dæn Ten deers ate the peaches (7)

/m/ mɒ'hi 'kæm 'ʔæb mixo'e The fish drank some water (7)

/n/ ni'ki ʔæ'nɒro 'nun xor'de Niki has eaten pomegranate and bread (8)

/l/ tu livɒ'næn ke'lido 'gol A Key and the flower in the glass (7)

/j/ 'kej 'jɒs mi'jɒd When is Yas coming? (4)

/ʔ/ ʔej'næko sɒ'ʔæt xæri'dæm I bought the glasses and a watch (8)