Non-verbal Speech: A Phonological Investigation Into The Utterances of a Non-verbal Individual with Autistic Spectrum Condition

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Submitted in accordance with the requirements for the degree of Master of Arts by Research

York St John University

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April 2021

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

Ethical Clearance Code RECll00016.

Acknowledgements:

Thank you to the gentleman known here as Simeon, his family, and countless others inspirational, and vocal.

For the wonderful people at Glyne Gap School.

For Musti.

Abstract

Do the vocalisations of non-verbal people display phonological influence? It is known that Autistic Spectrum disorder (ASC) presents barriers to achieving fluency in a language. These barriers are often negotiated by utilising Alternative, Assistive Communication systems (AACs) that can rely on signing and symbolic awareness. This can leave the vocal behaviours of non-verbal people in a non-communicative space, often explored in Intensive Interaction, and social games. This research investigates the vocalisations of Simeon, a young man with ASC, who is non-verbal, but vocalises socially. Exploring the relationship between Simeon's vocalisations and the phonologies of his home languages provides an insight into the ways he appears to align with the phonetics of his environment. The analysis explores the influence of three distinct language variants: Central Thai, Isan, and South East British English. The influence of these language variants is tested by comparing their phonemic inventories with the phones Simeon articulates. The tones of Thai and Isan as well as English patterns of intonation are compared to the pitch contour patterns found in Simeon's vocalisations. Simeon's articulation of vowels are subjected to formant analysis and compared to the articulations of his parents. In this approach, the paper addresses the question in a way that is respectful to the rights of the participant, but also critical of over-application of phonological theory. Instead a middle space is identified between the apparent phonetic systems present in the data, and language-centred phonology.

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Abbreviations

AAC - Assistive Augmentative Communication

ExtIPA - Extensions to the International Phonetic Alphabet

F1 - Formant 1

F2 - Formant 2

FC - Facilitated Communication

HFA - High Functioning Autism

IPA - International Phonetic Alphabet

PMLD - Profound and Multiple Learning Disabilities

SLD - Severe Learning Disabilities

Introduction

This research explores the effect of the linguistic environment on a non-verbal individual's vocalisations. This exploration observes linguistic features that can be found in vocalisations that can be described as non- or pre-linguistic. These features are identified by subjecting non-verbal utterances to phonetic transcription and analysis and exploring and adapting the ways that phonological investigation can be used when discussing inherently non-linguistic vocalisations.

This research focuses on the non-verbal utterances of a 20 year old blind man with Autistic Spectrum Condition (ASC) who is referred to in this work as Simeon. Simeon has not yet produced single word utterances purposefully and as such has been described as non-verbal for the purposes of this research. Simeon's communicative capacity extends to a number of on-body or close proximity signs which he uses throughout the day to make his needs met. To fully frame Simeon's ability to communicate, a review of literature regarding non-verbalism and the literature around it is included so as to provide a strong understanding of what communication can look like in developmentally impaired environments. This exploration explores language, communication and disability, with a special interest in conditions which can be described as non-verbal.

Simeon comes from a bilingual home where English and Thai are both spoken by his parents and siblings. The effects that multilingual upbringing can have on the phonological development of infants has been documented both in cases of Autistic Spectrum Condition and in neurotypical language learners. Both investigations typically observe the acquisition of phonological features as part of the communicative development of the learner. This study differs from its precedents in that it is not observing babbling as part of infant development, but instead looking at the phonological features in a young adult's non-verbal vocalisations outside of the lens of development. Previous phonetic investigations into non-verbal utterances are found almost exclusively in developmental studies. Consequently preceding studies will be used

for methodological structure and practical purposes, despite the difference in participant age, and expectation of further development.

The reasons for this investigation arose initially from anecdotes regarding the participant specifically that framed him as occasionally producing vocalisations that teaching staff would mistake for words in Thai. These anecdotes were not uncommon to me, during my time working with the school, and similar sentiments had been said about other pupils with EAL families as well. These anecdotes appeared to arise from a perceived distinction between the non-verbal vocalisations of pupils with EAL families, and that of their peers from Native English speaking families. This study explores whether or not a non-verbal individual from an EAL background demonstrates phonological features from their linguistic environment in their vocalisations.

Interviews with Simeon's parents and teachers produced a number of anecdotes detailing instances where he appeared to "sound Thai." The case for this was so convincing for Simeon's teachers that at one point they wrote home to ask if the utterances Simeon produced were in fact Thai words. This was not the case. Simeon's parents have not witnessed any instances of his vocalisations approaching meaningful words in English or Thai, but could confirm that there have been times that his utterances appeared similar to random Thai words out of context. Further similarity was noted in his pitch contouring, but also appeared to mimic conversational intonation phrases from his English speaking environments. With this in mind, the research is concerned primarily with answering the following questions:

1. Does Simeon appear to produce phones or pitch contours that align with his perceived linguistic environment?
2. Does Simeon demonstrate similar syllable structure to his perceived linguistic influences?
3. Does Simeon produce phones in a similar way to his parents?

These questions place Simeon's vocal behaviour in a linguistic context despite not being necessarily linguistic, but it is the hypothesis of the study that, when observed phonetically,

- Simeon can produce utterances that are phonetically and tonally similar to those found in his linguistic environment.

This study will begin to explore this matter with a review of literature regarding the key themes of Speech, Language, and Communication, as well as language and disability and the relevant developmental stages of language acquisition in both the autistic and neurotypical learners. After this the research method will provide two profiles regarding Simeon, the first describing him and his personality, and the second regarding the linguistic environments he has been exposed to throughout his life with special attention paid to the languages spoken in the home. After these profiles, the methodology of the study will be described. The results and discussion detail the findings and their implications, leading to the conclusion where the implications of the study will be explored, and so too the potential for further study.

Literature Review

The literature surrounding non-verbal vocalisations is largely concerned with assisting and observing the acquisition of language in infants with Autistic Spectrum Condition (ASC). This is largely done through the construction and execution of intervention plans by Speech and Language therapists, in order to address the many obstacles clients can face when acquiring communicative language. Consequently the relevant literature predominantly focuses on nonverbalism through a developmental lens rather than the phonetic patterns that may be found in nonverbal utterances. This will not be treated as grounds to criticise contemporary clinical literature, but merely highlight that there is a present lack of studies with a descriptive phonological approach to nonverbal vocalisations. The literature on this matter will be explored and ideological distinctions may be highlighted, but the methodologies and practices of the field will be the primary focus of the review.

Speech, Language, and Communication

For the purpose of discussion regarding this topic it is helpful to build an understanding of certain terms to avoid ambiguity when discussing the vocal behaviours of non-verbal or minimally verbal individuals. This is to be clear on what is meant by speech, language and communication, as these are terms which can be misconstrued. Furthermore a clear description of what is meant by vocal behaviour will be explored so as to ensure a clear understanding of this phenomenon within context as well.

Contemporary research into non-verbal and preverbal vocalisations are predominantly concerned with the linguistic development of infants with Autistic spectrum condition and/or developmental disorders (Garrido et al 2017; Bartak, Rutter & Cox, 1975; Maljaars et al, 2011; Schoen et al, 2011; Trembath et al, 2019). Common practice within these investigations is defining non-verbal vocalisations as either speech-like or non-speech-like utterances (Garrido et al. 2017; Trembath et al. 2019; Schoen et al, 2011). This is in line with an effective means of assessing and discussing the vocalisations of neurotypical children in the babbling stage of development (Kuhl 2004; Kuhl & Meltzoff 1996). The effect of this distinction allows for the measurement of phonological development in the Autistic language learner (Garrido et al. 2017; Trembath et al. 2019; Paul et al 2011). This distinction may also provide insight into what is meant by speech, by way of observing what is considered the most like it. Oller et al. (1999) speaks to a voice quality that identifies a likeness to speech, while Paul et al (2011) expands on this claiming that the production of consonants and/or vowels which can be represented by phonetic symbols also contribute to a likeness to speech. Paul et al (2011) explains that non-speech vocal quality typically consists of squeals or growls while speech-like vocal quality resembles typical babbling at a regular volume. This description provides a definition of speech to mean demonstrating typical phone production. So then if one could describe a speech-like utterance as one which adheres to the conventional phone production of language use (Oller et al. 1999; Paul et al. 2011), we are left with an understanding of speech being that which can be described as the typical form of language use.

This leads to the matter of what is meant by language. This question is difficult to answer convincingly without delving into philosophical debate but can be observed functionally in this field. When observed through the lens of pathology, Language appears to serve as the ideal means of communication, and is often the target of assistive interventions in the case of impaired development. This position can be inferred from the prescription and functions of Alternative Augmentative Communication (AAC) practices (Creer et al. 2016; Holmqvist and

Thunberg 2018; Renshaw et al. 2012; Battye 2017). AAC systems range from highly technical programs which allow for people with reduced motor control to make requests using eye gaze technology (Battye 2017; Renshaw et al. 2012) to physically exchanging photographs of desired objects or activities (Battye 2017). AAC systems are designed to overcome difficulties in language production capacity by simplifying construction or using alternative means to construct messages by using pictures and/or symbols to represent words, with the intention of bridging the gap between the language proficient and the language impaired (Battye 2017). Naturally this supports an understanding that language is the typical means of communication, and that being able to produce a message that can be interpreted by language users is the ideal.

Furthermore, observing AAC practices can help to build a strong definition of communication as well. Battye (2017) and Renshaw et al (2012) paint a picture of communication as message construction for the purpose of meeting needs. This then can be understood in context with our definition of language - as the ideal means of communication - as language production is largely assisted by AAC systems which can allow for effective language use (Battye 2017, Renshaw et al 2012; Holmqvist and Thunberg 2018; Creer et al 2016).

The most commonly found term used to describe the vocal behaviours of non-verbal or prelinguistic communicators is the term vocalizations (Garrido et al 2017; Bartak, Rutter & Cox, 1975; Maljaars et al, 2011; Schoen et al, 2011; Trembath et al, 2019; Keen et al 2016). This term can be used to describe any and all behaviours involving voice, and is often used to describe babbling behaviours (Garrido et al 2017; Plumb and Wetherby 2013; Oller et al 1999; Ozonoff et al 2010).

Non-verbalism and The Prelinguistic Stage of Development

Keen et al (2016) work to introduce what they refer to as the prelinguistic period of development and what skills are learned as prerequisites to language as well as how best to coordinate

interventions to assist and maintain key communicative skills for people with ASC. The works published in the journal they introduce speak on how best to assess and discuss prelinguistic communicators; those who can be described as nonverbal or minimally verbal (Keen et al 2016). They describe the Prelinguistic period as the time between birth and when one begins to use words meaningfully, going on to say that this typically occupies the first 18 months of a child's life, wherein the infant develops symbolic understanding and intentional communication skills (Keen et al 2016) as well as babbling and early phonological skills (Baron-Cohen and Staunton 1994; Plumb and Wetherby 2013). Keen et al (2016) explain that although the typical pattern of development is quite short, in the case of people with ASC, development can appear delayed, and some early communicative behaviours can appear absent altogether. Keen et al (2016) explain that people with ASC who do not develop the prerequisite skills required to move beyond the prelinguistic period can remain in this phase indefinitely, leading to them receiving labels such as nonlinguistic, preverbal, non-verbal or minimally verbal. Keen et al (2016) recognise that these labels when used to describe people with autism seem to be referring to the same population, and consequently make it hard to accurately identify exactly how common non-verbalism actually is.

Tager-Flusberg and Kasari (2013) estimated that 30% of people with ASC do not go on to acquire productive language skills sometimes even despite therapeutic interventions, and specialist education. This is further supported by Keen et al's (2016) finding which stated that people who entered into intervention programs as minimally verbal communicators completed the process with the same or similar profiles. Tager-Flusberg and Kasari (2013) explain that despite not knowing why language seems to elude this population, it is understood that this demographic is highly variable, which makes it difficult to provide a single explanation as to why linguistic development is rare for this group. The variability of language development skills this demographic can present also contributes to a difficulty in accurately applying a consistent label to define them (Tager-Flusberg and Kasari 2013). Evidence of inconsistent usage of labels throughout the literature on this topic is easily found. Kasari et al (2008) defined their low-verbal participants as children with fewer than 5 words based on observational and standardized assessments while Yoder and Stone (2006) defined their low verbal infant participant group as those who presented fewer than 20 words across three language sample recordings. Differing still, Koegel et al (2009) included 3-4 year olds with no functional words or object-label correspondence. Each of these papers claimed to be observing the same or similar demographic, but a clear difference in the communicative capacity of their participant groups

makes it difficult to use each source for the same purpose. Tager-Flusberg and Kasari (2013) claim that inconsistent labeling such as this occurs because there is no clear way to distinguish between nonverbal and preverbal participants in the field of prelinguistic communication without observing the full developmental path of each individual. This difficulty when observing infants is that it can become difficult to discern whether the participating children are preverbal - meaning that they will go on to develop expressive language skills - or are non-verbal - meaning that they will not (Tager-Flusberg and Kasari (2013). Such a distinction is evidently important to maintain for meaningful discussion regarding this population, but difficult to separate when observing prelinguistic communicators across a number of observations where the participant does not appear to develop towards word level utterances (Tager-Flusberg and Kasari 2013).

Tager-Flusberg and Kasari (2013) highlight the importance of clear labelling when working with participants who occupy the prelinguistic stage of development, but also the problem with inconsistency that can be found in the literature. As such for the purpose of meaningful discussion it is necessary to establish consistent labels for this population. In the interest of using clear labels to talk about prelinguistic communicators, each label outlined by Keen et al (2016) will be briefly explored and measured in its accuracy in definition of the intended population. The approach Keen et al (2016) take is important here, as they make no grand judgment about using one label over another, and seem to assume equivalency across a lot of them. However, some distinctions will be made between these labels, and for the sake of clarity some terminology will be preferred. The label “preverbal” can be seen to indicate an assurance of future verbalism (Tager-Flusberg and Kasari 2013), which may well apply when discussing people who have acquired language since the point of observation. Its application when discussing someone who has not yet acquired language ought to be avoided as doing so may appear prescriptive, or potentially groundless, as many people with ASC do not go on to develop meaningful language skills (Keen et al 2016). To label someone as “non-linguistic” may also appear unnecessary at times, as it can be seen to make judgements about an individual’s comprehensive capacity. One may be able to receive and follow instructions given in more than one language (Kremer-Sadlik 2005), but not necessarily be able to respond in verbal forms. As such the terms non-verbal and minimally verbal remain (Keen et al 2016), which can be perceived to describe two subsets of the population. The term non-verbal may appear heavy handed in its definition of individuals who occupy an extended prelinguistic period, but it may be applied in circumstances where using labels such as “pre-verbal” may appear too presumptuous of future development. “Minimally verbal” however may be used to describe individuals who use

word forms but not necessarily meaningfully - it has been used to describe people who have not yet acquired language (Tager-Flusberg and Kasari 2013) but to use the word minimal in this context may at times appear euphemistic or ambiguous about just how many words an individual may be able to produce (Kasari et al 2008; Yoder and Stone 2006). Consequently, each of the terms appear to refer to the same or at least similar demographics and can be used to accurately describe any number of people who have not acquired language at the time of observation, (Keen et al 2016) but none of them appear to accurately serve as an umbrella term either. It would appear that the term non-verbal best describes individuals who have not yet acquired language and do not appear to demonstrate features of language acquisition or linguistic development.

Conventional language development is well documented with older literature largely concerned with stages of development, and more recent studies observing morphological acquisition and babbling patterns. Morgan and Wren (2018) reviewed literature on the matter of early vocal behaviour in neurotypical learners, and highlighted a general consensus that features of infant babbling can be indicative of how easily language will be acquired in the learner (Camp et al 1987; D'odorico et al 2011; Oller et al 1999). For example, Camp et al (1987) and D'odorico et al (2011) both found that increased volume of babbling in infancy can be associated with increased vocabulary acquisition. D'odorico et al (2011) found that increased babbling complexity can have a similar effect on increasing vocabulary at the word level stage. Oller et al (1999) found that the inverse also appears to be the case, where delayed canonical babbling skills can be linked to impaired language acquisition skills at the word level. This can be linked to Keen's et al (2016) point regarding the prelinguistic period of development being difficult to leave without the acquisition of prerequisite skills. Oller et al (1999) only speak to reduced productive vocabularies in their work but when considering Tager-Flusberg and Kasari's (2013) concerns regarding the ambiguous and at times euphemistic use of labels regarding people who do not go on to acquire language, one may assume that Oller's et al (1999) conclusion can be applied to the nonverbal population as well.

Plumb and Wetherby (2013) observed the babbling patterns of children with ASC and came to a similar conclusion to Oller et al (1999) regarding babbling skills. Plumb and Wetherby (2013) found that a similar delay in canonical babbling skills was present in the prelinguistic stage of language impaired children with ASC. This adds further credence to Oller's et al (1999) findings, but Plumb and Wetherby (2013) are careful to not treat the delay of canonical babbling skills to

be an effective way to identify the onset of ASC, as it did not appear uniformly across all of their autistic participants. Instead, Plumb and Wetherby (2013) propose that a more effective way to identify early onset ASC is to observe non-canonical babbling features of the participants' vocal behaviours.

Bartak, Rutter and Cox (1975) found further cause to avoid using language delay as a means of identifying early ASC symptoms. Bartak, Rutter, and Cox (1975) observed the measures of language impairment between children with Autistic Spectrum Conditions (ASC) when compared with children with receptive language disorders without ASC. The study found that the autistic participants displayed a distinctly different level of impairment in speech reception to participants with receptive language disorder (Bartak, Rutter, and Cox 1975). This difference in impairment and other more immediate behavioural distinctions between the two groups lead the authors to the conclusion that an impairment of language reception, or developmental delay is not necessarily a precursor to ASC (Bartak, Rutter, and Cox, 1975). One criticism of this study is that the participant sample is not broad enough. The authors of this study elected to observe only boys between the ages of 4 and 9 years, on account of a perceived difficulty in identifying ASC in girls at this age (Bartak, Rutter, and Cox 1975). This does not appear to be such a confounding matter in more recent studies in this field (Garrido et al 2017; Paul et al 2011), where the participant groups include boys and girls. Consequently, the findings of Bartak, Rutter and Cox's (1975) work may not be as representative of autistic language development and impairment as later studies, but when considered alongside Plumb and Wetherby (2013) as well as Oller et al (1999) and Keen et al (2016) we can begin to see that ASC has an especially unique impact on language acquisition, that appears to be primarily characterised by non-speechlike vocal behaviour (Plumb and Wetherby 2013; Bartak Rutter and Cox 1975).

Schoen et al (2011) examined the phonology and vocal behaviours of autistic children between 1;6-3;0 years. The study involved 30 children with ASC compared with 11 typically developing age-matched control participants, and 23 language matched control participants (Schoen et al 2011). Comparative study such as this is commonly found across this field (Ozonoff et al 2010; Paul et al 2011; Garrido et al 2017; Maljaars et al 2011), but this study can be commended for observing the benefits of matching participants with controls for both age and language. The data was gathered in the form of speech samples collected from parent-child or clinician-child play sessions (Schoen et al 2011). The data was coded into speechlike and non-speechlike vocalisations when observing the vocal behaviours of the ASC group. They found that the ASC

group demonstrated canonical babbling patterns which were comparable to those of their language matched peers, but also produced a higher concentration of non-speechlike sounds than their controls (Schoen et al 2011). This aligns with the findings of Bartak, Rutter and Cox (1975) as well as Plumb and Wetherby (2013) that it is not necessarily the phonetic features of the babbling that appear to indicate ASC, but more the non-speechlike vocal behaviours which arise around the same time. Furthermore Schoen's et al (2011) study found that the structure of the participants' speechlike vocalisations were linked to the language level of their language matched peers, in a way that was thought to be similar to typical development. In other words, the phone inventory of the toddlers with ASC was similar to that of the language matched control. Schoen et al (2011) went on to say that at the observed level, the production of atypical or non-speechlike vocalisations was the primary distinction between the participants and their controls and not any matter of phone inventory or apparent delay in phone acquisition. Schoen et al (2011) also posited that toddlers with ASC may not tune into the language model of their environment in the same way as typically developing infants, suggesting that if this were the case it would negatively impact on the linguistic development of the autistic learner.

The findings of the Schoen et al (2011) study are further supported by the findings of Sheinkopf et al (2000). Primarily focused with the phonological development of the participants, the authors found that their learners with ASC had comparatively less trouble with the acquisition of speechlike syllables than their peers with other developmental delays (Sheinkopf et al 2000). These findings appear to imply that the openness to phones and phonology that is typical in the early stages of development (Plumb and Wetherby 2013; Morgan and Wren 2018) may not be so affected by ASC as other areas of language acquisition. Similar to Schoen's et al (2011) study, Sheinkopf et al (2000) also found that non-canonical babbling occurred in much higher frequency from the participants with ASC, and that this was a lot more indicative of the population rather than any phonological or phonemic impairment. Also it was found that difficulty with joint attention behaviours was common among the ASC participants, but not to the same magnitude as atypical phonation (Sheinkopf et al 2000).

Maljaars et al (2011) focused on the function and forms of communication in non-verbal and/or preverbal children with autism and intellectual disability. The study was interested in all forms of communication and symbolic behaviour, which was then categorised into three main functions: joint attention; social interaction; and behavioural regulation (Maljaars et al. 2011). A lot of these communicative behaviours are described by Keen et al (2016) as prerequisite skills for the

acquisition of language. The data for this investigation was collected through video recordings so as to capture all potential forms of communication (Maljaars et al. 2011). The participant groups consisted of 26 children with autism and an intellectual disability, ranging in age between 3;1-11;4 years and across a broad spectrum of Intellectual Disability which was ranging from “mild to severe” according to a standardised cognitive ability test (APA 2000; Maljaars et al. 2011). The broad spectrum of need within the participant group meant that the study was drawn to focus on the general syndrome of autism rather than attempting to look at the whole spectrum, so as to make the group more homogenous (Maljaars et al 2011). This group was made up of 23 boys and 3 girls and all had Autism diagnoses which were confirmed by the researchers as part of the participant selection process (Maljaars et al. 2011). A second group of participants included typically developing children who took part in non-verbal intelligence tests and were individually matched with an autistic participant who occupied a similar developmental stage (Maljaars et al. 2011). The typically developing group included 11 boys and 15 girls, between the ages of 2;0 and 3;11 years (Maljaars et al 2011). One criticism of the study could be made at this point regarding developmental ages, and equating much older autistic people with the skills and/or sensibilities of infants. This can be seen as insensitive, as it can infantilize people with any level of intellectual impairment, and fall short of accurately describing participants. Maljaars et al (2011) does discuss the matter of developmental ages, frequently equating the results of standardized non-verbal intelligence tests to the participants’ mental ages. This study does very well to compare like with like in terms of non-verbal intelligence, and general communicative ability, but could do with avoiding such terms as mental or non-verbal age as it can carry with it a number of unnecessary connotations.

Maljaars et al (2011) found that in the typically developing group joint attention was the most common communicative function, and that behavioural regulation was the least frequent. Meanwhile the opposite appeared to be the case in the Autistic Development group, with behavioural and sensory regulation being the most commonly found function of communication among the non-verbal participants, with only very rare instances of declarative behaviour (Maljaars et al 2011). The findings of this study indicate that among the nonverbal participants, there is a generally low amount of intentional communication, and instead these individuals must rely on the interlocutor’s capacity to interpret their behaviours in order for their needs to be met effectively (Coupe O’Kane and Goldbart 2017; Grove et al 1999). This can be linked to Keen et al (2016) and other works that have found the primary distinction between people with ASC and typically developing learners in the prelinguistic stage of development (Schoen et al

2011; Bartak, Rutter and Cox 1975; Oller et al 1999). Maljaars et al (2011) take special care in their selection of participants, saying that potential participants with motor impairment were not included in the Autistic Development group on account of a perceived difficulty in measuring intentionality for these individuals (Iacono et al 1998). As such we can begin to see that nonverbal people with ASC and/or an intellectual impairment may face similar difficulties with perceived intentionality that such a heavy reliance on interpretation of behaviours can present as with those who have a profound physical need (Iacono et al 1998; Grove et al 1999; Coupe O'Kane and Goldbart 2017).

Ozonoff et al (2010) investigated communicative behaviours for potential onset signs of autism within the first 3 years of development. This longitudinal investigation compared 25 participants who later received a diagnosis of ASC with 25 gender matched children who were described as at risk, but demonstrated typical development (Ozonoff et al 2010). The participants were observed at 6 month intervals between the ages of 0;6-3;0 years, with a focus on face gazing, social smiling and directed vocalisations (Ozonoff et al 2010). Data was collected in the form of video recordings so as to effectively observe the desired social behaviours. At the initial observation - where the participants were all 6 months of age - the observed social behaviours appeared to be comparable between the two groups. However a clearly declining trajectory was apparent in the ASC group by the 12 month observations (Ozonoff et al 2010). This trajectory continued as the participants aged, and led the research to discuss an apparent loss of skills in the ASC participant group (Ozonoff et al 2010). The paper in its conclusion observed that autistic behaviours are not apparent from birth but instead emerge as a diminishing of key social behaviours (Oznoff et al 2010). Furthermore the study found an inconsistency with parent reports of their children's development, and the apparently regressive course of ASC (Ozonoff et al 2010).

Although the suggestion that ASC may be a regressive condition appears to be unique, Ozonoff et al (2010) are not alone in their observations regarding impaired social behaviours. Keen et al (2016) make similar claims regarding joint attention skills beginning to emerge at the 0;6 age but occasionally appearing inconsistently or even absent in matters of atypical development. That being said, no findings were presented as to the precise nature of atypical development, merely broader descriptions of development with ASC, and how it deviates from conventional patterns of linguistic development (Keen et al 2016).

Trembath and Iacono (2016) frame a significant difficulty faced by speech and language pathologists in when it comes to measuring the true linguistic capacity of language impaired participants and clients. Typically this is done by the application of communicative intelligence tests that are often standardised with the intention of functioning as meaningful tools in diagnosis and intervention for people with ASC (Trembath and Iacono 2016). The effects of a testing standard appear to be a point of contention in regards to assessment practices. Trembath and Iacono (2016) take a comprehensive approach to listing the strengths and weaknesses of standardised testing for prelinguistic communicators. The investigation begins with observing the uses of standardised testing for people with ASC, and its primary strength in adequately identifying strengths, needs and potential diagnoses in the individual (Trembath and Iacono 2016). Furthermore, Trembath and Iacono (2016) explain the potential benefits of what are called “norm referencing” tools, which can be used to highlight the nature and effects of developmental disorders by comparing a client’s ability to that of conventionally developing communicator. However, one problem with standardised assessment practices is that a lot of the tools require some prerequisite skills that are not consistently found in people with ASC (Trembath and Iacono 2016; Keen et al 2016; Ozonoff et al 2010; Maljaars et al 2011). In their investigation Trembath and Iacono (2016) highlight the many challenges that standardised assessment practices face when observing prelinguistic, nonverbal or minimally verbal communicators. This aligns with the findings of Kasari et al (2013) who claimed that most standardised approaches have serious limitations when dealing with minimally verbal children. Trembath and Iacono (2016) identify the main difficulties of using standardised assessment tools, explaining them as threefold. The function and effect of utilising a standardised can be hampered significantly by: the widespread lack of appropriate tools for working with prelinguistic or nonverbal clients at the child, adolescent and adult level; a lack of evidence base to determine the best or most applicable assessment tools; the variable practicality of assessment application (Trembath and Iacono 2016). Despite the presence of standardised measures of cognitive intelligence and adaptive behaviours which do include some communicative behaviours, Trembath and Iacono (2016) frame a general lack of appropriate tools for nonverbal and prelinguistic clients.

An argument can be made that standardised assessment tools may never be adequate for prelinguistic or nonverbal communicators. Neisworth and Bagnato (2004) found that standardised tests were unable to provide meaningful insight while so many of them interrupted the daily routine of their clients so drastically. This argument can be found in Matson and

Smith's (2008) work as well, proposing that tests requiring participants to collaborate with unfamiliar or infrequently present professionals in an unfamiliar environment are likely to yield less than standard results and have been seen to heighten anxiety in clients. Arguing that standardised testing provides decontextualized results, Neisworth and Bagnato (2004) instead argued more flexible practice is mandatory for more accurate results. Neisworth and Bagnato (2004) proposed a form of testing which was: useful for intervention; acceptable to clients, carers, and clinicians; conducted in natural contexts; adaptable; sensitive to change; useful and interpretable multiple professional contexts; designed to foster parent-professional collaboration; relevant to the individual being assessed. Furthermore the Indiana Resource Centre for Autism (2015) argued that testing generally fails when it relies on clients to follow instructions - a finding reflected in Trembath and Iacono's (2016) concern about inappropriate tools for nonverbal or prelinguistic clients.

Ozonoff et al (2005) noted infrequent levels of motivation and high levels of distractibility and off task behaviours when attempting to test autistic clients. This finding appears to align with the concerns regarding the practicality of applying standardised assessment tools when working with prelinguistic communicators outlined in Trembath and Iacono's (2016) work. This matter appears to be supported by Bagnato and Neisworth's (1995) work, interviewing 250 psychologists about their ASC diagnostic practices. The participating psychologists felt that approximately 60% of their collective cohort of 7000 children with ASC would not have met standard testing parameters were it not for heavy modification of practice, and instead would be considered untestable (Bagnato and Neisworth 1995). This statistic appears daming as it essentially indicates that over half the time standardised practice fails to even begin to adequately assess people with ASC without adaptations away from the standard and towards more descriptive testing approaches.

Koegel, Koegel, and Smith (1997) conducted an experiment observing the motivations and attention to standardised testing procedures, and the impact on performance that it had for people with ASC. The study observed 6 autistic children performing in 44 testing sessions under 2 conditions: the first, precisely as directed by the test's manual; the second using strategies tailored to the potentially obstructive behaviours the participants may have presented or were identified in previous parent/practitioner observations (Koegel, Koegel and Smith 1997). Somewhat demonstrative of the shortcomings of the first condition, Koegel, Koegel and Smith (1997) explain the second condition with the anecdote: "One participant screamed when asked

to sit at a table. In the second condition the test was administered on the floor." Koegel Koegel and Smith (1997) found that the participants generally benefited from the environment of the second condition a lot more than that of the first, leading them to the conclusion that standardised approaches may only be measuring the child's test taking disability rather than intellectual or verbal ability. Matson and Smith (2008) found similar conclusions when observing the apparent decline in IQ of participants with ASC following periods of intervention. Rather than indicating a loss of skills, or even any real change in IQ, Matson and Smith (2008) instead observed a change in compliance behaviours which would typically allow for adequate IQ testing.

As such we can see standardised approaches towards the communicative capacity of nonverbal, prelinguistic, and minimally verbal autistic communicators are not the most appropriate clinical practice. From here we may also infer a high level of adaptability is key when conducting research with this population. Perhaps using Neisworth and Bagnato's (2004) list of qualities to conduct effective and meaningful research.

Adjacent to the investigation of nonverbal utterances in Autistic development is the study of infants who are likely to receive ASC diagnoses later in life. This population is often described as at risk, and are often observed with the intention of finding early indicators of onset ASC by looking at their vocal behaviours (Garrido et al 2017; Paul et al 2011). Paul et al (2011) observed the preverbal vocalisations of infants who were identified as being at risk of a later ASC diagnosis. The participating infants were identified as being at high risk of future ASC diagnosis on account of having an autistic sibling, while the participants that did not were considered low risk (Paul et al 2011). This was part of a longitudinal study to compare the language development of high and low risk infants (Paul et al 2011). The participating infants took part in vocalisation recording at 6, 9, and 12 month infant and mother play sessions with standard toys (Paul et al. 2011). The primary focus was on the difference in preverbal vocalisations between infants at high risk of a future ASC diagnosis, and those at low risk. The study found that high risk participants did display certain vocal distinctions from the low risk group (Paul et al 2011). The method here is much the same as the previously discussed studies involving preverbal or nonverbal vocal data: a low structure, low pressure environment where the participant may engage vocally as often or as little as they wish, with the sole interest in observing what happens.

A reliance on recording interactions between parents and children is a common methodological practice when observing the preverbal and nonverbal vocal behaviours (Maljaars et al 2011; Schoen et al 2011; Garrido et al 2017; Paul et al 2011). This practice often takes place in staged environments with controlled stimuli such as toys so as to provide consistent or similar reasons to vocalise (Paul et al 2011; Maljaars et al 2011). Xu et al (2014) offer an alternative to the controlled environment which appears to shed greater light on naturally occurring vocal behaviours through naturalistic recordings. Xu et al (2014) describe one application of this practice as placing a recording device about the personage of participants and categorizing vocal behaviours captured over extended periods of recording. Xu et al (2014) used automated software to categorize vocal behaviours which allowed for the processing of data collected over periods of up to 8 hours. Xu's et al (2014) data was collected from the day to day routines of the participants and needed very little in the way of staging or organising the way that Paul's et al (2011) study and others like it (Maljaars et al 2011; Schoen et al 2011). One downside to this method is the time it takes to collect data in this way would require extended access to the participant in order to ensure adequate conditions for recording. Xu et al (2014) navigates this matter by working closely with the parents of the participants to ensure the wellbeing of the participant at all times. This practice seems to be the most organic way of collecting vocal data without dramatically affecting the routines of the participants.

Bearing in mind the strengths of both the naturalistic recording approach (Xu et al 2014) and the purposeful recording of interaction sessions (Schoen et al 2011; Garrido et al 2017; Paul et al 2011; Maljaars et al 2011), it appears that both methodologies rely on the participants' interactions with parents, researchers and/or clinicians. One popular communicative approach which is known to encourage social behaviours in nonverbal people is Intensive Interaction. Intensive Interaction is a technique of communication for people who do not use words (Hutchinson and Bodicoat 2015). The approach consists of preverbal communication techniques such as vocal mirroring, responsive eye contact, facial expressions, and joint attention activities in a way similar to how a mother would interact with an infant (Nind and Hewett 2001). This practice is well received in healthcare contexts, recommended by the Department of Health (2009), as well as being advised in teaching and care contexts as well (Caldwell 2007; Zeedyk 2008; Firth et al. 2010). It is for these reasons that a practice such as Intensive Interaction appears to be a complementary method to aid in the gathering of vocal data when observing preverbal and nonverbal vocalisations (Schoen et al 2011; Garrido et al 2017; Paul et al 2011; Maljaars et al 2011; Xu et al 2014).

Intensive Interaction as a communicative practice functions in two distinct ways, and some level of contention can be found in the literature regarding the primary function of Intensive Interaction (Hutchinson and Bodicoat 2015). Some argue that the primary function of Intensive Interaction is as a communication tool for those who typically face difficulty in communicating (Nind and Hewett 1994; Nind and Kellett 2002), while others see the practice as a route to enabling social engagement and inclusion (Leaning and Watson 2006; Caldwell 2007). Firth (2009) addresses this dichotomy through his Dual Process Model. The Dual Process Model (Firth, 2009) essentially states that either of the two functions outlined above can be found at different stages of familiarity with Intensive Interaction as a practice. Firth (2009) found that on the uptake of Intensive Interaction practitioners noticed a sharp increase in social engagement and inclusion, and once the client had acclimatized, the practice became more focused on long term communicative development. The viability of Intensive Interaction as a methodological practice for studies regarding nonverbal vocal behaviour becomes slightly nuanced with this in mind. If intensive interaction were to be used as a means of encouraging vocal behaviour, then it would benefit the study most for the participant to already be familiar with the practice. As Firth (2009) explains, upon the introduction of the communicative practice, and while a communicator may be learning to use these newly encouraged skills, the participant may be focused on producing entirely novel behaviours to explore their effect, rather than produce consistently found, or commonplace vocalizations. Firth (2009) recommends observing the communicative development of the learner after they appear familiar with the fundamentals of the practice, as the developmental profile at the early stages of introduction to Intensive Interaction can appear spiky and inconsistent. This could be avoided however, by ensuring that participants are familiar with Intensive Interaction prior to the study, and so the novelty of the practice has a lesser impact on their vocal behaviours.

Autism and Multilingualism

Considering what is known and unknown about why some people with ASC remain in prelinguistic stage of development for as long as they do (Keen et al 2016; Tager-Flusberg and Kasari 2013), parents often receive advice on how best to proceed in supporting the communicative development of their children from speech and language pathologists and other healthcare professionals (Keen et al 2016; Kremer-Sadlik 2005). Due to the variation within the non-verbal population, there is no reliable or regularly identified cause for this communicative delay (Tager-Flusberg and Kasari 2013), which can often leave the matter of how or why a child remains in the prelinguistic stage open to speculation (Kremer-Sadlik 2005). It is from this place of speculation that many healthcare practitioners and speech and language therapists advise against attempting to raise autistic children in multilingual environments (Kremer-Sadlik 2005). This section explores the ways in which the autistic language learner is first of all not hindered by multilingualism, and second of all able to demonstrate distinct phonological and linguistic sensitivity to more than one language.

Kremer-Sadlik (2005) conducted a study into the matter of bilingualism and autistic development, focusing on the advice provided to families who have more than one language in the home, by clinicians, and healthcare professionals. The study investigated the credibility of a commonly found instruction given to bilingual or multilingual mothers to avoid confusing their child by teaching them more than one language, and instead speaking to them only in English (Kremer-Sadlik 2005). This advice has been provided to a number of bilingual and multilingual families in my experience, as well as apparently found commonly in California, where the research was conducted. The study explored the validity of such an approach, and any potential ramifications for following it. Kremer-Sadlik (2005) begins by reviewing literature on the apparent impact of bilingualism on autistic development and found nothing to indicate it furthering any level of language impairment. Instead, Cummins (1979) was the only source to speak against the acquisition of a second language for the language impaired individual, and even then only went so far as to posit that if a learner is demonstrating impairment with their first language, achieving fluency in a second is less likely to succeed (Cummins 1979). This is the only source Kremer-Sadlik (2005) found that even slightly supported the notion that bilingualism may be difficult for an autistic child. However, Cummins (1979) does not speak against it on account of it being confusing, but merely from holding the position that language impairments do not appear to be specific to individual languages, but rather affects the capacity to acquire language (Cummins 1979).

Cummins' (1979) position is even challenged by Bruck's (1982) study which examined bilingual children with language impairments in Canada. Bruck observed the development of language impaired children who were learning both French and English, and found that native English speakers were able to acquire proficiency in French with little to no impact on their first language acquisition or any other faculty of their education (Bruck 1982). This indicates the complete opposite of the problem advice that Kremer-Sadlik (2005) investigated, and can be further supported by the findings of Crutcheley et al (1997) who found that bilingual children with semantic pragmatic disorder performed as well if not better than monolingual children with the same condition in a range of tests.

Kremer-Sadlik (2005) presents their own argument on this matter as well, which underlines an inherent ideological fault with the argument that bilingualism can confuse the autistic language learner. Kremer-Sadlik's (2005) argument can be summarised as follows: The advice against bilingualism or multilingualism can only apply in a monolingual culture, and fails to adequately account for nations and regions where bilingualism is not only the norm, but in fact necessary (Kremer-Sadlik 2005). The argument points to a school in India, where Hindi and English are taught together, in a part of the country where many of the children come from homes that may speak a third language (Kremer-Sadlik 2005). Many children in this school, as far as their impairments allow, do go on to acquire language, and use it effectively (Kremer-Sadlik 2005). This argument gives further credence to the previous studies (Crutcheley et al 1997; Bruck 1982), and does well to highlight the flaw in the notion that bilingualism is a sort of lifestyle choice that might not be appropriate for an autistic child by pointing to an environment wherein it is mandatory.

Having addressed the lack of supporting research for the widespread advice to bilingual families, Kremer-Sadlik (2005) goes on to highlight the potential ramifications of denying a child's access to their home language (Tseng and Felugni, 2000). Observing first the communicative difficulties it can impose in typically developing children, Kremer-Sadlik (2005) argues that autism already poses difficulties in matters of linguistic development (Frith 1989), sociability (Baron-Cohen 1993; Baron-Cohen et al 1985), and imaginative play (Kasari et al 2001) which can only serve to exacerbate the communicative breakdown and strained relationships that Tseng and Felugni (2000) detail in their investigation of relationships in families with language barriers.

As such, Kremer-Sadlik (2005) details a problematic and inaccurate ideal in the field of multilingual development that is often given as advice to parents on how best to raise their autistic children. Partially as a result of this poor advice, one can expect to face difficulty in identifying autistic second language learners who are in truly multilingual environments, rather than children raised in monolingual environments but with bilingual or multilingual parents. Consequently the nuance of bilingualism in autistic development may not be found in monolingual countries and cultures as easily as it can in others. Kremer-Sadlik's (2005) conclusion on the matter stated that although multilingualism may present some obstacles to the autistic language learner, the implications of raising them as monolingual English speakers appears to have a weighty impact on the individual's social development and relationships in the home.

Ben-Zeev (1984) explored the cognitive development of bilingual children, and outlined a number of defining features of bilingual children with cognitive impairments. This has special prominence when observing the linguistic development of people with ASC as at the babbling stage, the distinction between learners with and without autism appears to be through the presence of non-speechlike vocal behaviours (Schoen et al 2011). Ben-Zeev (1984) clearly defines three linguistic environments which can lead to what they consider to be four distinct forms of bilingualism. The first form of bilingualism is described raising a child in a first language until they begin attending school where a second language is spoken (Ben-Zeev 1984). It is said that this has the greatest impact on the development of vocabulary (Ben-Zeev 1984). The other two linguistic environments which lead to distinct forms of bilingualism can arise from being raised in a bilingual home, with the crucial difference being around the boundaries between the first and second language (Ben-Zeev 1984). A bilingual environment with clear functions for either language, such as conversation with a specific family member, yields a different form of bilingualism to what can arise from an environment with frequent code switching between the first and second languages seemingly at will, with no clear boundaries between the two languages (Ben-Zeev 1984). These distinctions are intuitive and effective. Ben-Zeev (1984) explains that these forms of bilingualism can have distinct impacts on reaching milestones of language acquisition especially in respect to vocabulary growth. One common cause of seemingly delayed vocabulary growth in typically developing bilingual children is as a result of semantic and syntactic differences between the two languages which can lead to confusion and hampered confidence in the effective use of certain words (Ben-Zeev 1984). Ben-Zeev (1984) explains that such an impairment to vocabulary growth is often as a result of the language

learner's budding understanding of language as a system, and is only really obstructive because the child is uncertain of how best to use certain words or expressions which might have different semantic and syntactic values across the two languages. Consequently an impairment in this way is unlikely to be found in a bilingual learner who has a cognitive impairment that might otherwise affect their ability to observe language in such a complex way (Ben-Zeev 29184). This is an interesting position held by Ben-Zeev (1984) which can be aligned with the findings of Kremer-Sadlik (2005) which argue that bilingual and multilingual upbringing is not detrimental to the autistic language learner. Where many studies present arguments for the benefits of a multilingual environment, and challenges the argument that it in some way confuses or impairs the child (Kremer-Sadlik 2005; Bruck 1982; Cummins 1979), Ben-Zeev (1984) presents a case that it is unclear whether children with cognitive impairments may have a complex enough understanding of language to become confused in the way that typically developing bilingual children can often be.

Simon Baron-Cohen explores the ways in which language acquisition is affected by autism. One of the primary symptoms of Autistic Spectrum Condition is abnormal social development (Baron-Cohen, 1988; American Psychiatric Association, 1987). It is often around early school age that autism is diagnosed, as this is typically when peer-to-peer socialising begins, (Baron-Cohen, Allen, & Gillbury, 1992), as well as a time when second languages are introduced for some (Ben-Zeev 1984). Baron-Cohen and Staunton (1994) investigated autistic participants' phonologies and from where they took their primary phonological influences. The study observed the phonological development of children with autism who came from bilingual households, in order to observe whether or not the participants adopted the phonologies of their peers, as is often the case in typical development (Baron-Cohen and Staunton 1994). The study was formed in order to test the dynamics of the abnormal social development found in Baron-Cohen's previous work (Baron-Cohen, 1988; Kanner, 1943; Rutter 1983). The results found that 87% of the autistic participants displayed clear features of their mother's accent, while only 12% could be said to be speaking with an accent in line with their peers (Baron-Cohen and Staunton 1994). This is indicative of influence from parental speech that appears to outweigh that of the autistic individual's peers which would normally become their primary linguistic influence at that age (Baron-Cohen and Staunton 1994). These findings indicate that the abnormal social development of people with ASC (Baron-Cohen 1988; Kanner 1943; Rutter 1983) appears to inhibit the shift of primary phonological influences that occurs in typical development when a language learner begins to socialise with peers (Baron-Cohen and

Staunton 1994). Instead Baron-Cohen and Staunton (1994) present that the majority of the time, ASC can preclude the language learner from acquiring phonological features from their peers, either as a feature of the abnormal social development itself or perhaps as an indirect result of another feature of the condition. In some ways this finding may demonstrate another obstacle for the autistic bilingual language learner. If school becomes the primary source for second language interactions - in a way that Ben-Zeev (1984) describes - Baron-Cohen and Staunton's (1994) finding may indicate a general difficulty in the acquisition of phonological elements of the second language. That being said, Kremer-Sadlik (2005) contends that multilingual environments where school speaks an additional language to home still thrive in special schools in India. Furthermore Bruck (1982) found that language impaired Canadian children were able to achieve a level of fluency in both English and French in certain circumstances. The strength of this position ought to be tested further, but the variability of language impairment that can be found within the prelinguistic or non-verbal label makes it very difficult to measure the effectiveness of a multilingual linguistic environment without taking into account the ambiguous likelihood of future language acquisition in the participants (Tager-Flusberg and Kasari 2013). Consequently, it is hard to say how this finding would truly affect the autistic multilingual language learner, if at all, but Baron-Cohen and Staunton's (1994) work displays a clear preference for the phonologies of home languages over those of their peers.

The implications of Baron-Cohen and Staunton's (1994) study are important and beg further questions pertaining to the effects ASC can have on phonological and linguistic development. One question that arises from this study is a matter of linguistic identity. The Baron-cohen and Staunton (1994) study observed children with autism raised in bilingual families, and found that the participating children developed phonologies which aligned more often with that of their mothers than their peers at stages where typical development would see the opposite. In these cases, does the autistic language learner demonstrate the phonology of a second language learner without necessarily achieving fluency in a first language? To illustrate the question, if a child with ASC was raised in Bristol by French parents, would they learn English with a French accent even if they had not achieved fluency in French first? The indication of Baron-Cohen and Staunton's (1994) study is that children raised in these circumstances do, so then can one expect to see similarities between the development of this child, and a typically developing child raised by English parents in Nice? These questions are fascinating, as the study appears to touch on a distinct linguistic identity for autistic language learners in their apparent consistency in phonological influences. Furthermore the findings of this study may be linked to the

investigations into non and minimally verbal vocal behaviours and their apparent similarity to the canonical babbling of typically developing infants. For instance we may use Baron-Cohen and Staunton's (1994) insight into this feature of atypical phonological development to better understand what is meant by speechlike and non speechlike sounds in real life contexts. If Baron-Cohen and Staunton's (1994) study can be applied in this context, one can expect to find phonological inventories similar to those of the speaker's parents.

Peppé et al. (2006) investigated the receptive and expressive capacity for people with ASC to parse prosody. It was the belief of the researcher that autism can affect the capacity of an individual to accurately recognise and utilise prosodic features in speech (Peppé et al., 2006). To test the impact autism has on prosodic capacity in receptive and expressive contexts, Peppé et al. (2006) formulated a group study of 31 children with what was described as "High Functioning Autism," excluding people with Asperger's syndrome - a distinction which no longer is recognised by the American Psychiatric Association (American Psychiatric Association, 2013). The reason for this distinction was that people with Asperger's do not present any difficulty in the acquisition of their first language (Peppé et al. 2006; Macintosh & Dissayanake, 2004), and so are assumed to present no difficulty in the acquisition of the nuance of prosody . The study also built a control of 72 "typically developing" people "with matching mental and verbal age" (Peppé et al., 2006). As previously mentioned, the matter of developmental age is inconsistent. Peppé et al. (2006) also produced a case study of one seven year old individual with ASC. The findings largely indicated an impaired level of prosodic comprehension, where the case study participant often misunderstood utterances which relied on prosody for their meaning (Peppé et al. 2006). These findings were later explored in relation to the parsing of prosody in bilingual and multilingual contexts, and the ways in which a receptive and expressive understanding of prosody in the first language may affect its interpretation and use in the second (Peppé 2012; Peppé et al 2006).

Peppé (2012) explored the use of prosody in the linguistic development of bilingual learners. It was concluded that in general there exists a tendency for the prosodic features of the first language to influence the use of prosody in the second language (Peppé 2012). This presents a curious case for people who generally struggle with the acquisition and functional use of prosodic features in their first language, as appeared to be the case with the participants of Peppé's et al (2006) earlier study. Coupling this matter with Cummins' (1979) point that

language impairments are rarely limited to single languages, but instead can be expected to affect the entire linguistic development of the learner, one can expect to see similar levels of impairment to prosodic processing in the second language as Peppé et al (2006) found in the first language. With this in mind, one can assume that a language learner with ASC may generally struggle with prosodic features in both first and second languages. That being said, the nature of the impairment may need greater investigation to truly define.

As such we see here that the autistic language learner can demonstrate a number of developmental features which may function as obstacles to the acquisition of multiple languages. Some of these obstacles are: the potential for semantic and/or syntactic differences between two languages affecting the speaker's confidence in either language (Ben-Zeev 1984); the phonological preference for the home language variant as depicted by Baron-Cohen and Staunton (1994); difficulty in accessing prosodic features of a language, and the potential for this difficulty to carry over in the acquisition of multiple languages (Peppé et al 2006; Peppé 2012). Each of these apparent features of ASC linguistic development can present obstacles in achieving fluency in more than one language, but at the same time, none of these problems seem damming enough to advise against bilingualism or multilingualism for the autistic language learner, especially when considering Bruck's (1982) evidence to its credit, and Kremer-Sadlik's (2005) argument against linguistic isolation in the home.

Method

Ethical approval was sought to proceed with the investigation and was granted by the Cross-School Research Ethics Committee at York St John University, evidence of which can be found in Appendix A, on page 114 of this paper. Once ethical approval had been received, the participant selection process began.

The participant hereafter referred to as Simeon was selected from a pupil list of individuals attending a special needs school in the south east of England. The school provides education and support for pupils with Profound and Multiple Learning Disabilities (PMLD) and Severe Learning Disabilities (SLD), between the ages of 4-18. With consent from the head teacher the

school was able to provide a comprehensive list of pupils who have access to more than one language at home. From this list, I was able to identify pupils who fit this demographic and also were occupying the prelinguistic stage of communicative development (Keen 2016). All this information was available to me with the express consent from the head, as I was a member of the learning support staff there at the time of conducting the research. Consent to contact the parents of identified pupils was requested from the governors of the school. This was granted, and so the parents of the potential participants were contacted via a letter gauging interest in taking part in the research. Of the consenting families, one participant was selected to proceed with the study on account of the nature of his vocal behaviours and low expectation of him to go on to acquire language.

Informant Profile

Simeon is a 19 year old male individual with complex autistic needs and is blind. Simeon's capacity to walk and perform fine motor tasks such as to drink from an open cup are entirely unaffected by his condition. Simeon can demonstrate a high level of spatial awareness that allows him to navigate his home environment independently but is often in the company of family or support staff when not in his room. Although requiring little to no physical support, Simeon requires assistance to walk in the community both for directional guidance, and for help in emotional/behavioural regulation. Simeon is believed to have been blind from birth which is likely to have an impact on his ability to accurately reproduce certain phonemes precisely, as he cannot receive visual direction, and receives language purely audibly.

Simeon enjoys robust sensory experiences which normally take the form of audibly complex music, to which he will often dance, jump, and rock to. During sessions involving loud music Simeon enjoys dancing with an assistant, with whom he will rock, and jump, occasionally exploring how high he can jump, with assistance. Simeon also enjoys knocking on hard objects, stamping his feet, and biting hard wood textures. Some of these behaviours are not always appropriate for social environments, but Simeon responds well to verbal requests to stop. In terms of food and drink, Simeon prefers dry crunchy textures such as crisps and biscuits, occasionally chips and chicken nuggets also, he does not enjoy tacky or soft textures such as bread or cake. At home, Simeon eats with his family, often having chicken rice and peas. He is

able to feed himself. If there is an ingredient with which he is not happy, Simeon will isolate the undesired food in his mouth and spit it into his hand, and throw it behind him. Simeon can be quite defensive about the stimuli he does not enjoy and so will tend to behave as though he does not like objects or textures he has not experienced before. This is true in all manner of stimuli, and as such a list of things Simeon does not like is not easily discerned. That being said, Simeon does demonstrate strong feelings against especially adverse weather conditions, as well as sudden loud noises, and unexpected hand holding. These can startle Simeon, and can at times lead to him displaying challenging behaviours.

Simeon is able to communicate a desire for more or less of a stimulus by using a number of body-centric signs that are based around the Canaan-Barrie (Lee and MacWilliam 2002) on-body signing system. Simeon can produce a formalised sign for more, which takes the form of a single head nod. This is also accepted as a positive response in matters of choosing between stimuli. Simeon demonstrates an expressive and receptive understanding of the Canaan-Barrie sign for ‘stop,’ which manifests as a clap in front of the face (Lee and MacWilliam 2002). This is often used to comment on stimuli such as unwanted food or a disliked texture, and can be diexical in cases such as the taking of a piece of croissant, pinching it, placing it down and clapping to indicate a negative feeling towards the object. Simeon is able to provide a second negative response which takes the form of closed hands tapping on the hips or outer thighs in an approximation of the Canaan-Barrie sign for ‘finish.’ This sign is often understood as an alternative to the stop sign, and is used interchangeably. Similarly, Simeon’s ‘finish’ sign can sometimes manifest itself as an exaggerated shrug, which is also accepted as a negative response in day to day communication with family and close support workers. Throughout the research, all forms of the positive and negative responses listed above were accepted so as to ensure a maximum of communicative clarity and maintaining Simeon’s safety and comfort as a priority. Simeon is able to greet people with an improvised sign that involves steepling his fingers in front of his forehead and touching his head with his fingertips in an approximation of a wai greeting (Rajadhon 2015). This sometimes requires the prompting of a supporting family member or staff by asking him to say hello, or goodbye. This was one of the first signs Simeon learned and was taught to do so in Thailand. Simeon also uses an improvised sign for requesting use of a bathroom. This entails an open hand tap on his own trousers, normally while seeking the attention of a supporter simultaneously.

Simeon is able to communicate some basic ideas effectively. The entirety of his signing and communication can be described as ensuring and maintaining his own comfort and

convenience. While Simeon has shown progress in the learning and development of these signs, there is no intention or great level of need to see his signing lexicon increase. Alongside his signing, Simeon's family and support staff also rely on a level of behavioural understanding, and proactive emotional support that allow Simeon to remain happy and safe throughout the day.

Simeon is able to dress himself effectively, but often needs support in the arrangement of clothes on the body which may be the wrong way round, or inside out. Simeon requires support in personal care tasks such as keeping clean both generally and topically. While he can put on and take off outerwear and slip on shoes, Simeon may require support to regulate body temperature. This is often supported with encouragement to take off or put on additional layers of clothing.

Presenting Simeon simply by way of physical and cognitive needs indicates that he is largely quite an intelligent and capable individual in PMLD terms (Hogg, 2004; Ware 2004). However, it is important to discuss Simeon's behavioural needs in order to provide a full picture. To do so I will adopt a past tense. This is because it is important to discuss these needs purely in terms of what Simeon has demonstrated in the past, rather than what he could be capable of. To do otherwise runs the risk of misrepresenting Simeon, which this research has no interest in doing.

Simeon has presented behaviours that were self injurious and have hurt those around him. Some of these behaviours have included violence such as hair-pulling, biting, and pinching. Sometimes these behaviours have come from places of distress and other times these have been explorative, assurance seeking, or even playful behaviours. During the collection of the data, none of these behaviours presented themselves. Some behaviours that did present themselves in the collecting of data included skipping, and the biting of clothes, especially zips. Throughout the data collection, Simeon displayed no adverse or distressed behaviours.

Simeon was known to me in an educational/professional context prior to the research, as I had worked in his class a number of times in the past, although never consistently. With the intention of developing a rapport with Simeon, before conducting the research, I began working with him approximately twelve hours a month, on Sundays, supporting him to attend church, access

cafes, go for seaside walks. This routine was upheld for a number of months prior to the beginning of the data collection process. The data collection process involved the audio recording of Intensive Interaction sessions that occurred often while engaging in other activities such as walking, playing instruments, listening to music, eating outside in a cafe etc. During these Intensive Interaction sessions, Simeon would vocalise, and I would often respond with repetition where able, or providing positive comments on the nature of utterances I could not repeat. I knew this to be a source of amusement for him, from the periods of time spent with him prior to the data collection period. These sessions provided 16 recordings varying in length between 2 and 25 minutes. This method of data collection reflected the nature of interactions between myself and Simeon on our walks and time together both before and after the data collection session. In this way, the use of Intensive Interaction essentially functioned as a nonverbal conversation of creative utterances which can in some ways be likened to conventional means of eliciting informal talk data for phonological analysis. In the evaluation of such a practice, one could note the potential for phonemic coaching from the researcher, as the low structure of the communicative practice can often involve stimuli of some kind as a means to encourage interactive behaviour (Hewett 2009; Nind 1999; Hewett and Nind 2013). Simeon was not intentionally provided with any stimuli to encourage vocalisation, but always received a verbal narrative of his surroundings, as part of the support I provided for his visual impairment. At some points in the data, Simeon is provided with low volume music, and/or a musical instrument, both of which became focal points for our interactions.

Linguistic profile:

Once consent had been secured from Simeon's family, a series of informal interviews with his parents were conducted in order to construct a linguistic profile detailing his potential phonological influences. On top of this, Simeon's parents were recorded reading from word lists respective to the languages in which they spoke to him in the home. This was to provide an understanding of vowel realisations by either parent, as Simeon's father predominantly spoke to him in Isan Thai, while his mother spoke to him mostly in English. The intention for this information was to compare Simeon's vowel realisations to those of his parents to see if his articulations align with native speakers of his potential linguistic influences. Likewise,

phonological profiles for both Isan Thai, and South East English were formed, including phonotactics, and tone contouring in either language. These became the four criteria by which influence would be measured. The profile was expanded to also include an outline of Simeon's physical, and sensory needs, and discussing the means by which he is expected to communicate. When combined, the intention is to provide a complete and relevant depiction of Simeon and his phonological home environment.

With the help of his parents, a linguistic profile outlining the influences Simeon may have been exposed to, throughout his life was constructed. The result of this interview drew three eminent linguistic influences present in the development of the participant: Central Thai, Laos or Isan Thai, and South East English. Figure 1 outlines the source of each linguistic influence.

Age	**Languages**	**Influence**
0;0-0;6	Unknown	Unknown
0;6-2 years	Central Thai	This was the language used by staff at the orphanage that Simeon attended in Thailand.
2-7 years	Isan Thai (North Eastern Thai)	Isan is the first language of Simeon's grandmother who was his guardian for this period. (adopted) Father also speaks Isan, as well as Thai.
7-20 years	Isan Thai (North Eastern Thai) and South East English	Father predominantly speaks to Simeon in Thai. Mother and siblings speak English with a South East dialect. Siblings are both fluent in Thai. Father is Fluent in English also.

fig 1

Table of Simeon's Linguistic Influences

As can be seen in figure 1, Simeon has been exposed to three potential influences: Central Thai; Isan Thai; South East English. Simeon has had access to Isan Thai for the longest period of time, amounting to some 18 years of potential influence as this is the variety that his father and grandmother speak. South East English has been present in Simeon's life for approximately 13 years. These regional language variants were considered to have the potential to influence Simeon's vocal behaviours. The expectation was that if Simeon were to demonstrate any phonological influence he would display sounds from his most frequently heard languages, much like the findings of Baron-Cohen and Staunton (1994).

Review of literature regarding Simeon's home languages

Simeon's primary, and most consistent Thai influence has been his father, who speaks a North Eastern variant of Thai similar to the Lao language, known as Isan Thai. Isan is a language variation that has mutual intelligibility with Lao. While speakers of this variant understand Central Thai, they are not always understood by Central Thai native speakers (Bradley 2010). Simeon's father explained that Central Thai is the variant taught in schools in the Isan region. The potential for influence from Central Thai arises predominantly from Simeon's time spent at an orphanage in Bangkok - where the dialect is commonly found. Simeon was very young during this period but this dialect will be explored nonetheless.

Isan

Accent variation is common across Thailand, although documentation of regional dialects and the phonological differences they carry is scarce (Bradley 2010). It can also be said for Laos, Cambodia, Vietnam, and Burma that the specific nature of the dialects and even minority languages present in these populations are currently under-researched (Bradley 2010). The

following review of Isan Thai will be supplemented with the insight of Simeon's Father's understanding of his own dialect, and the language use present in his hometown. Simeon's father has experience teaching Thai as a second language to missionaries and so is believed to have some capacity to make informed comments on language use. Isan is closely related to the Lao language, and is one of the most distinct dialects present in Thai (Bradley 2010). Bradley defines the Isan region as the north-east part of Thailand, where local speech consists of various varieties of Lao, and is more related to the national language of Laos than Central Thai although speakers from this region tend to be literate in both (Bradley 2010). Linguistic minorities in the north-east of Thailand are predominantly Khmer with migration from Burma, such as Karen, Lahu, Lisu, Akha, Shan, and Khmu (Bradley 2010), it is not believed Simeon has had access to these languages in any influential way.

Isan phonology can be considered distinct from Thai in a number of small ways, including the transition from the aspirated affricate /tɕʰ/ found in central Thai, towards the alveolar fricative /s/ (Bradley 2010). Thai is intelligible to the Lao speaker, and the two nations tend to share radio, television and written media, as well as textbooks in educational contexts (Bradley 2010). Speakers of central Thai have difficulty understanding most forms of Lao, due to the lack of exposure and sociolinguistic dynamic of the region (Bradley 2010; Enfield 2006). That being said, Isan songs produced in north east Thailand are very popular across Thailand, and are understood both by Thai and Lao speakers (Bradley 2010). Erickson (2001) notes a feature of Isan consonants in the distinction of labialised consonants such as /sʷ/ and /kʷ/. No other sources acknowledge this, and so this feature will be put aside from the further discussion for the consistency of considering /w/ a consonant in its own right. Without contradicting Erickson's (2001) findings in such a way, it benefits the investigation to explore the nature of the paper, and its credibility. As previously stated, there exists a paucity of research into the particular nuance of dialects in this region (Bradley 2010), so one can expect to find papers noting features that do not appear to be recognised by other researchers. For this reason I believe it fair to observe the findings of Erickson's (2001) paper with the intention of marking the phonological inventory there found, and applying a level of skepticism to the paper, as informed by other texts such as Bradley (2010), Enfield (2006), and the account of the participant's father in constructing a coherent outline of the Lao phonological system.

The consonant inventory Erickson (2001) provides is influenced by this notion of labialisation, and consequently is depicted in figure 2.

	labial	Alveolar	Palatal	Velar	Glottal
Plosive	p pʰ b	t tʰ tʷʰ d	tɕ tɕʷ	k kʰ kʷ kʷʰ	ʔ ʔʷ
Fricative	f	s sʷ			h
Nasal	m	n	ɲ	ŋʷ ŋ	
Approximant		l lʷ	j	w	

fig 2

Isan Consonant table (Erikson 2001)

However, when addressing the matter of labialisation through transcribing such circumstances with /w/ exclusively, the inventory becomes figure 3.

	labial	Alveolar	Palatal	Velar	Glottal
Plosive	p pʰ b	t tʰ d	tɕ	k kʰ	ʔ
Fricative	f	s			h
Nasal	m	n	ɲ	ŋ	
Approximant		l	j	w	

fig 3

Alternate Isan Consonant Table (Erikson 2001)

Of these consonants, all may be found in the initial position but only: /m/, /n/, /ŋ/, /p/, /t/, /k/, /w/, and /j/ may appear in final positions, along with the glottal stop /ʔ/ appearing where no final consonant follows a short vowel (Erickson 2001). Erickson also explains that /p/, /t/, and /k/ are unreleased when found in final position (Erickson 2001). Erickson (2001) explains that all vowels make phonemic distinctions between short and long forms, and diphthongs all glide to /ə/. The vowels of Lao consist of the close vowels /i/, /ɯ/, and /u/, the close-mid /e/, /ɤ/, and /o/,

the open-mid /ɛ/ and /ɔ/, and the open /a/ alongside the diphthongs /iə ɯə uə/ each of these vowels has a long variant (Erickson 2001).

Isan phonotactics are generally characterised by the unstressed minor syllable that precedes the presence of a major syllable (Enfield 2007). As such, the phonotactic formula can be described as follows:

$$C_0V_0C_1V_1V_2C_2$$

Enfield (2007) p32

Enfield presents the unstressed minor syllable by the notation C0, and V0, explaining that if one is realised, both are found in the syllable (Enfield 2007). Enfield explains further that C1 and V1 are always realised but do not form a word segment of themselves, and are followed by either V2, C2, or both in the construction of a syllable. C1, V1, V2, and C2, comprise the major syllable which often carries the tone (Enfield 2007). Minor syllables do not carry tone independent of the major syllable, and have restricted initial consonants in the C0 position (Enfield 2007). /b/ is not found in this position, and neither are palatal or nasal consonants, while V0 can only be /a/, /i/, /u/ without length contrast (Enfield 2007). Enfield (2007) explains that long variants of vowels are represented in this model as a single vowel articulated twice - in V1 and V2 position. In contexts wherein V1 and V2 are not identical, /i, u/ occupy V1 position, while V2 is always /a/ (Enfield 2007). In general, words in Lao do not have more than one major syllable, but words that do tend to be loan words (Enfield 2007).

The usage of tone in Isan is inconsistently reported over time. Relatively contemporary investigations have found that the language has 5 lexical tones (Enfield 2007;Crisfield & Hartmann 2002) while other, older sources have found that the language harbors between 6 and 8 distinct lexical tones (Brown 1967; Simmonds 1965; Yuphaphann Hoonchamlong 1981; Compton 1970). As outlined by Enfield (2002;2007) and the works of Crisfield and Hartmann (2002) Isan tonology is made up of 5 parts: mid, high rising, low rising, high falling, and low falling. This disparity between the more recent research (Enfield 2000; Enfield 2007), and the older investigations (Brown 1967; Simmonds 1965; Yuphaphann Hoonchamlong 1981; Compton 1970) can be attributed to the sociological, and political turmoil that Laos as a nation has faced, along with the difficulty in producing a standardised national language (Enfield 2000).

With this information in mind, the observation of Simeon's utterances can now lead towards potential discussion around influence from his Father's language use. Establishing a phonological, tonological, and phonotactic understanding of Isan enables the comparative study of Simeon's own utterances as potentially influenced articulations.

Central Thai

Simeon's access to Central Thai comprised the 18 months of his life where he resided at an orphanage, between the ages of approximately 6 months and 2 years old. This period is highly formative in matters of linguistic development as a neurotypical infant of such an age is expected to develop babbling skills (Harley 2001). The cognitive impairments, and disabilities Simeon exhibits preclude him from such linear development (Simmons and Bayliss 2007; Hogg 2004), nonetheless the extent of influence from Central Thai is yet to be measured, so will be explored to the fullest extent. It is unlikely that Simeon has been exposed to Central Thai since his time in the orphanage, but it benefits the study to observe the possible signs of influences in his vocal behaviours.

Slayden (2009) provides a research-based summary of the Central Thai dialect. Framing both the phonological structure and the numerous previous studies into the language, Slayden carefully highlights the intricacies of the language's tonology as well as conflicting sources at the debatable points of phoneme notation (Slayden 2009). As a phonological source, Slayden's work provides a wealth of studies cited over a period of some 60 years, (Slayden 2009). The paper sheds critical insight both into the phonology of Central Thai and into its study in a robust and comparative review.

In the provision of a Thai phonemic inventory, the works of Diller (2008), Iwasaki (2005), Tingsabadh (1993), Abramson (1979, 2001), Harris (2001), and Noss (1964) as well as Slayden (2009) will be explored. Noss explains the choice not to include the glottal stop [ʔ] in the list of Thai consonants, on account of it often only presenting itself in specific stress environments (Noss 1964). With this in mind, Slayden (2009) further posits that all listed consonants and zero can be found contrastively in syllable initial positions, and goes on to explain a three way

distinction between voicing and aspiration in Thai's stop consonants particularly in the bilabial /p/, /pʰ/, /b/, and the alveolar /t/, /tʰ/, /d/ stops (Slayden, 2009). Harris' work expands on the three way distinction, stating that that the voiced aspirated phoneme is rarely used contrastively, but a similar voiceless aspirated distinction can be found in the contrastive phonemes /k/, /kʰ/ as well as in the post alveolar affricates /tç/, /tçʰ/ (Harris 2001).

	Labial	Alveolar	Palatal	Velar	Glottal
Plosive	p pʰ b	t tʰ d		k kʰ	ʔ
Nasal	m	n		ŋ	
Trill		r			
Affricate			tɕ tɕʰ		
Fricative	f	s			h
Approximant			j	w	
Lat. Approx.		l			

fig 4

Central Thai Consonant Table (Slayden 2009)

Diller (2008) outlines the position of the remaining consonants, including the nasal stops /m/, /n/, /ŋ/; the fricatives /f/, /s/, and /h/ all of which are voiceless and the alveolar articulations including the trill /r/ and the approximant /l/. The list is completed with the addition of the approximants /j/ and /w/, both of which are difficult to note cleanly when compared to the diphthong system (Slayden 2009; Diller 2008). Nonetheless, Slayden highlights the fact that Central Thai phonology appears to favour alveolar sounds, from which seven of the twenty sounds originate (Slayden 2009).

While all twenty of the aforementioned sounds are permitted in the syllable initial position, a subset comprising ten consonant phonemes, and zero are permitted in the syllable final position contrastively (Harris 2001). The consonant phonemes found in syllable final position consist of /p t k m n ŋ s f j w/ (Harris 2001). The phonemes /f/ and /s/ primarily exist in Thai loan words such as the word for ‘golf’ which in Thai may be transcribed as /kɔ́f/ and the Thai word for ‘gas’ /kɛ́s/ (Tingsabadh 1993). It is a point of contention that /j/ and /w/ can be considered present where it is also possible to treat such sounds as diphthong segments when following a vowel (Slayden 2009). Tingsabadh (1993) expands on matters of consonant clustering by underlining the prohibition of /j/ and /w/ in final consonant clusters, indicating that they are treated as glide finals and not diphthong segments. Consonant clustering in Central Thai adheres to specific phonotactic rules, predominantly found in syllable initial positions where /l/ and /r/ follow /p/, /pʰ/, /k/, /kʰ/ (Iwasaki 2005). Occasionally /r/ may follow /t/ but never the aspirated form /tʰ/ (Iwasaki 2005).

Brown (1979) and Abramson (2001) produce a list of nine vowels each with a contrastive long variant. Brown’s work (1979) summarises an argument against the contrastive nature of long vowel variants, but Abramson’s (2001) study into the stability of Thai vowel length yields evidence of contrastive meaning which warrants their inclusion. With this in mind, the vowel inventory comprises: the high front vowels /i/ and /iː/; the mid front vowels /e/ and /eː/ and the mid low /ɛ/, and /ɛː/ all of which are unrounded; the low central /a/ and /aː/ vowels, unrounded; the back high vowels /u/ and /uː/; the mid /o/ and /oː/ as well as the mid low /ɔ/ and /ɔː/ all of which are rounded; the near back vowels /ɤ/, /ɤː/ and /ɯ/, /ɯː/ (Henderson 1975).

Diller (2008) explains that long high vowels present an opportunity to form diphthongs by preceding /a/ in certain circumstances. This is not the case for short variants of the high vowels (Diller 2008). In this way, Diller provides a list of diphthongs thus /iːa/, /uːa/, /ɯːa/, (Diller 2008). Other diphthongs include /iu/, /eu/, /ɛu/, /au/, /iau/, /ai/, /ɔi/, /ui/, /ɤi/, /uai/, and /ɯau/ (Tingsabadh and Abramson 1993). The second list of diphthongs can only exist with the decision to record sounds which could be interpreted as /j/ and /w/ as vowels instead of approximant consonants (Slayden 2009). This discussion surrounding /j/, /w/, /i/ and /u/ does not seem to yield a vast impact on the phonology of Central Thai empirically, and so my instinct is to elect one argument over the other, for the sake of brevity in discussion. As such I will be favouring /j/ and /w/ going forward.

Allophonic variation can be found in the alveolar trill /r/ very often being replaced by /l/, and both can be deleted in initial clusters (Bradley 2010). Other variables include /s/ being realised as /θ/, and /k^hw/ produced as /f/ (Bradley 2010). The nature of these variables show a pattern of social stratification (Beebe, 1975) with the /s/→/θ/ mainly restricted to lower status Bangkok speakers (Bradley 2010).

The syllable structure of Central Thai is as follows:

(C1)(C2)V+T(/a/)(C3)

Iwasaki (2005) p3

The initial consonant - which is called C1 - is always optional (Iwasaki 2005). As mentioned before, this position can be occupied by any consonant (Harris 2001). In contexts where the C1 position is occupied, constraints surrounding consonant clusters are placed on the phoneme taking the C2 position - which may only be occupied by /r/, /l/, or /w/. V represents any monophthong, T is indicative of tone. Slayden (2009) reiterates that /a/ may follow any monophthong so as to form a diphthong. Finally C3 may consist of /p/, /t/, /k/, /m/, /n/, /ŋ/, /j/, /w/ or zero (Iwasaki 2005).

Slayden (2009) highlights a discrepancy surrounding just how many contrastive tones are present within Central Thai usage (2009). Tingsabadh (2001) posits that there are five contrastive tones in Thai - these consist of high, low, mid, rising, and falling while the works of both Noss (1964) and Mcfarland (1944) seem to posit a sixth glottally constrained high tone as well. Tingsabadh's (2001) account of tones will be used for the purposes of this research, as it appears to be the most thorough, and recent account of Central Thai tonology, and the absence of any mention of the constrained sixth tone indicates that it may not be noteworthy anymore.

Abramson's (1979) study into Central Thai's tonology finds that Thai tones are irreducible in that they can't be dissected into more fundamental elements. Abramson's (1979) study explores tone use in dynamic speech, rather than isolated or citation language, which allowed for descriptive findings surrounding the use of tones in situ. It is because of this, that Abramson was able to identify that the coarticulation of laryngeal tones is in free variation (Abramson 1979).

Tingsabadh (2001) presents their findings on Central Thai's phonological classifications of live and dead syllables. Live syllables are expected to end with sonorant sounds such as nasals, glides or long vowels, whereas dead syllables end in short vowels and oral stops. Tingsabadh (2001) documents the features of the five tones present in Central Thai. The mid tone is pitched within normal speaking range and exhibits no contour. The rising tone climbs through the mid tone's range. These two tones are only found in live syllables. Low tone is pitched one step below mid and can be found in both live and dead syllables. Falling tone begins high and falls to a pitch lower than mid. Finally the high tone begins one third of an octave above mid tone and rises. (Mcfarland, 1944; Haas, 1956; Abramson 1979; Slayden 2009).

South East British English

Simeon's mother has lived in the South East of England for at least 15 years, and speaks English with a near RP accent.

Wells (1982) explores the phonologies of English used in the South East of England. This is done by first outlining the phonology of RP and then discussing the regional variance (Wells 1982). The comparative way in which Wells (1982) presents English accents warrants a rudimentary outlining of their writings on RP before being able to meaningfully talk about South East British English.

Wells (1982) provides a vowel inventory for RP which purposely excludes schwa. This is because the stress environments wherein /ə/ may be found are restrictive enough to warrant treating the phoneme as a stress feature, rather than a vowel of its own accord (Wells 1982). Wells posits that within RP there are six short vowels /ɪ, e, æ, ʌ, ɒ, ʊ/ which may be called 'checked' vowels due to the phonotactic constraint that they may only occur in stressed monosyllables when there is a final consonant (Wells 1982). A checked vowel is distributionally different from a free vowel which are either long vowels or diphthongs (Wells 1982). Free vowels are called so because they are able to occupy a monosyllable with or without a final consonant

(Wells 1982). Free vowels are the long vowels /iː, uː, ɜː, ɔː, ɑː/ and the diphthongs /eɪ, ɔɪ, aɪ, əʊ, aʊ, ɪə, ʊə, ɛə/ (Wells 1982).

Wells provides a consonant inventory for RP and explains that while usage varies quite dramatically regional variations in consonant inventory are very rare within the UK (Wells 1982).

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Palatal	Velar	Glottal
Plosive	p b			t d			k g	
Nasal	m			n			ŋ	
Fricative		f v	θ ð	s z	ʃ ʒ			h
Affricate					tʃ dʒ			
Approximant				ɹ		j	w	
Lat. Approx.				l				

fig 5

South East British English Consonant table (Rogers 2000)

Once RP is established, Wells talks on London English, describing it as a median point between RP and Cockney (Wells 1982). Wells provides a vowel list which contains the same six short or checked vowels as RP: /ɪ, e, æ, ʌ, ɒ, ʊ/ alongside notably different free vowels: /ʉː, oː, ɜː, ɑː, ɪi, ʌɪ, ɑɪ, oɪ, ʌʊ, æʊ, ɒʊ, iə, eə, ɔə, uə/ (Wells 1982). The South East English accent is heavily influenced by London English, as well as RP, and throughout the home counties, the variance in vowel usage tends to be placeable between the two inventories (Wells 1982).

Wells (2006) explores the presence of tone and intonation in English. Wells explains that intonation is non-lexical, but can be used to express linguistic and pragmatic meaning in speech (Wells 2006). Sometimes referred to as prosody, or suprasegmentals, the English system of intonation is characterised by tonality, tonicity, and tone (Wells 2006). This idea is expanded upon by Halliday and Greaves (2008). Tonality is the means by which the speaker chooses to segment their spoken material (Wells 2006; Halliday and Greaves 2008). Wells (2006) explains that it is common to find speakers forming tonal segments or Intonation Phrases (IP) that align with spoken clauses. The example provided in the text is:

"|Because I love languages |I am studying intonation.|| When I've finished this book,| I'll know a lot more about it|"

Wells (2006) p6

Each clause is marked with a | symbol at the beginning and end. Wells' (2006) example is a complex sentence that, when spoken aloud, can be articulated in four intonation phrases. Wells describes the difference of each of these IPs as having individual tunes. With this example, Wells shows that the English speaker tends to formulate one IP per spoken clause (Wells 2006). Wells explains that intonation in English is not something that people can get dramatically wrong, as can be found in the accommodations made by natives for EFL speakers (Wells 2006).

Tonicity can be explained as the placement of emphasis, and accent in an IP (Wells 2006). English speakers use tone to highlight the importance or significance of a conveyed meaning, by placing special accent on the stressed syllable of a word (Wells 2006). For example one could look at the word ridiculous, and place tone on the stress of the word, to emphasise the meaning to produce: ri/dículous (Wells 2006). Wells describes this as applying a change in pitch or pitch direction to the nucleus ***dic*** in a way that affects a change on the rest of the word (Wells 2006). The nucleus is the primary stress position of an IP, and can sometimes be referred to as the tonic, or the intonation centre (Wells 2006). If an IP includes an accent before the nucleus, it is referred to as an onset, and the number of syllables between an onset and the nucleus is called the head (Wells 2006). An example of such a phenomena is provided in the utterance:

"It was re'markably \good"

Wells (2006) p8

The syllable *mark* carries an accent that affects the remaining syllables of the world *remarkably*, before the IP reaches the nucleus ***good*** (Wells 2006).

Once the nucleus is identified in an IP, the speaker allocates what tone occurs at that point (Wells 2006). English tones can be placed into two categories: falling tones, and non-falling tones (Wells 2006). Wells posits that high and low rising tones both share a meaning with a normal level rising tone, and the same can be said for the high, low and normal level falling tones (Wells 2006). It is occasionally worth differentiating between rises and fall-rises (Wells 2006). A taxonomy of English tones according to Wells (2006) would essentially be as follows: rising, falling, rise-falls, and fall-rises.

Wells addresses a generalisation around tone usage: statements fall; questions rise (Wells 2006). Wells' position here is that while it holds to some level of accuracy, it seems to ignore the fact that statements in English are allowed to have a rising tone, and questions may have a falling tone (Wells 2006). Wells contends that no predictable relationship between sentence type and tone can be found (Wells 2006). That being said, there can be merit to asserting "default tones" to sentence structures, which typically outline the expectations of tonal choice that may be influenced by the nature of the utterance (Wells 2006). These default tones are:

- Falling tones for statements, exclamations, open questions, and commands (Wells 2006)
- Rising tones for yes or no questions (Wells 2006)

Another helpful generalisation provided by Wells surrounds utterances with two or more intonation phrases - these observations are

- A falling tone in the first IP (Wells 2006)
- A non-falling tone in the subsequent IP (Wells 2006).

Wells (2006) moves on to detail the anatomy of falls and rises respectively along with the more complex fall-rises and rise-fall tone patterns. Typically the fall can be found in definitives, and the fall-rise can appear implicational (Wells 2006). Furthermore, rises can appear in declarative questions and falls can also be used in questions such as "so we'll be free by \six then?" (Wells 2006). Wells' (2006) work in this area seems well sourced and grounded, and provides a detailed insight into English intonation mechanics. The subsequent writings around this matter appear to heavily rely on this work (Halliday and Greaves 2008; Roach 2009), but occasionally differ in choice of terminology (Roach 2009).

Parents' Vowel Plots

Simeon's parents were recorded reading from lexical sets that outline the vowels in English (Wells 1982) for his mother, and Thai for his father (Tingsabadh and Abramson 1993). Once collected, the readings were subjected to vowel formant analysis akin to the works of Joos (1948) and Veatch (1991). Formant analysis allows for the plotting of vowels on a chart according to their F1 and F2 values (Joos 1948). The F1 value of a vowel is inversely proportional to its articulated height, while the F2 value is directly proportional to the vowel's backness (Joos 1948; Veatch 1991). When placed on a chart with the ranges found in figures 6 and 7, one can produce a quadrilateral of vowels similar to that found in the IPA, but with vowels as they are produced in the recordings. Figure 6 contains the plotted Thai vowels of Simeon's father, as read from a Thai lexical set (Tingsabadh and Abramson 1993). Figure 7 contains the plotted English vowels of Simeon's mother, as read from an English lexical set (Wells 1982).

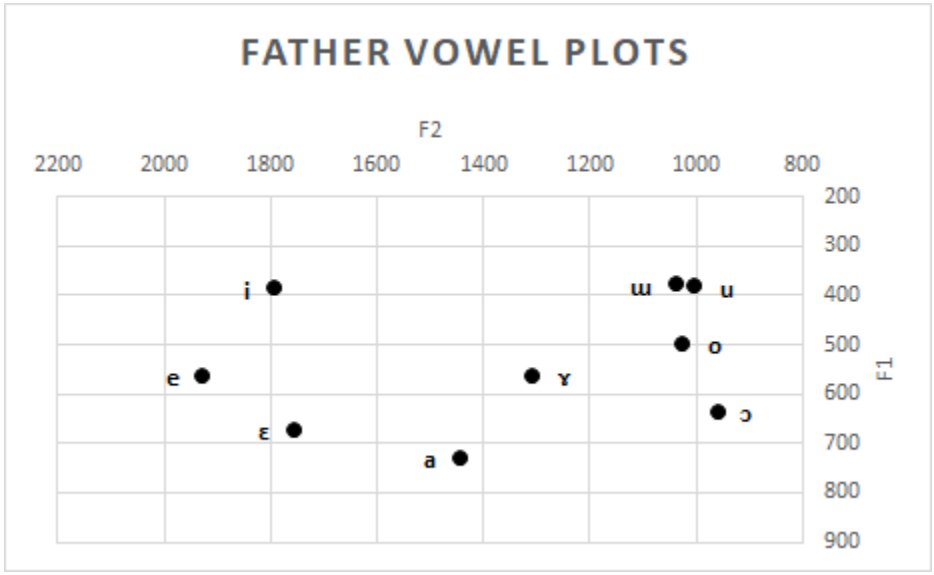

fig 6

Simeon's father's vowel plots

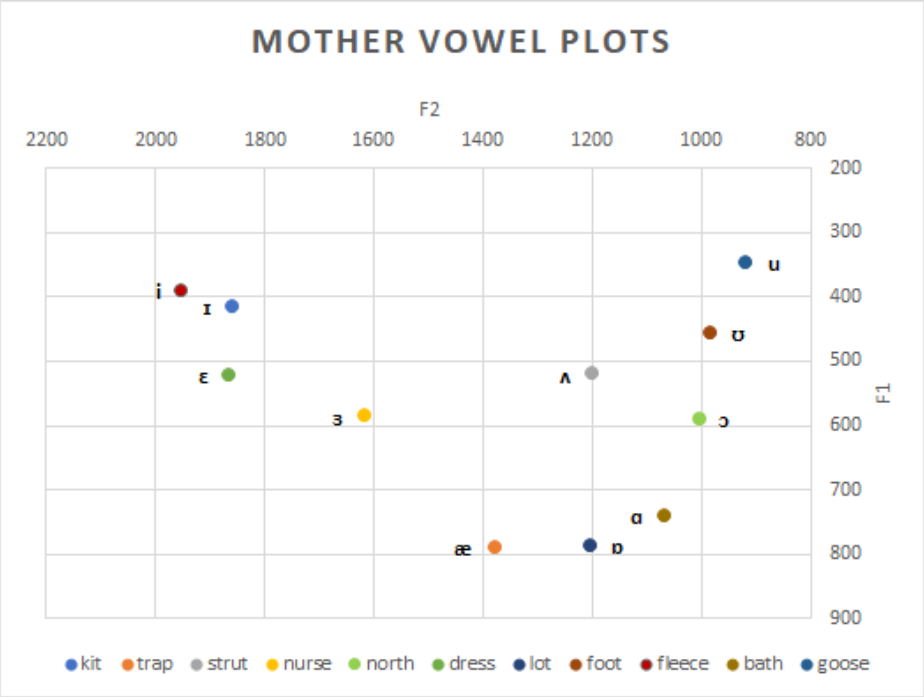

fig 7

Simeon's mother's vowel plots

This is not a replication of the IPA's vowel quadrilateral, but instead indicates where articulations may be found in the articulations of Simeon's parents.

Summary

The expectation of the research was that Simeon might demonstrate phone production that aligns with his potential linguistic influences. One could note the similarities in phonemic and tonal inventories between Isan and South East British English. While lexical tones are a feature of Isan, and Central Thai, the use of conversational tones found in South East English can also be identified as using falling, rising and rising falling tones. Likewise phonetically, one might observe a close similarity between the Lao influenced Isan inventory, and Central Thai, but also an overlap in phonemes between these two and South East English once again. These overlaps in phonology may make it difficult to isolate any one language as an influence at times. This problem is addressed by adopting an holistic approach to Simeon's linguistic profile. As a non-verbal individual, Simeon's adherence to the specific dynamics of any one language is not

expected to be very high. The interest of this research is if there are any signs of phonetic alignment with influences in his vocalisations. As such the research treated the languages present in Simeon's profile as potential contributors to the influence of verbal language as a whole. In this way, the research observed Simeon's utterances in the interest of finding any implications of phonetic consistency which may then align with his potential linguistic influences. In this way, the collation of a phonemic inventory for each language served as a lens of potential influence toward language, as did the collation of tonology and phonotactics of his linguistic environment.

Methodology

The design of the study attempts to answer the research questions by way of first accruing sources regarding the phonology, phonotactics, and pitch contours of each language and comparing these linguistic features to Simeon's vocal behaviours present in the data. 16 Intensive Interaction sessions lasting 10 minutes on average were recorded between Simeon and the researcher across 3 contexts. 10 recordings were taken from interactions on weekly walks along a familiar seaside route, while 4 were taken from interactions at home, playing with instruments and with music on in the background and the final 2 were taken from interactions had outside a local café. The distribution of these recordings was not intentional, and instead arose from where and when Simeon appeared to be comfortable and happy. The recordings were taken while Simeon and I were engaged in regular activities that were part of a familiar routine. This part of the design of the study was in the hopes of gathering naturalistic data which captured Simeon's regularly occurring vocal behaviours. The data collection process can be linked to a number of preceding studies for several reasons. The intention to record interactions between researcher and participant is commonly found among clinical studies regarding the measuring of linguistic development (Sheinkopf et al 2000; Trembath et al 2018; Plumb and Wetherby, 2013; Ozonoff et al, 2010; Paul et al 2011). However in the interest of collecting naturalistic results, the recording device was often placed or held nearby while Simeon and I interacted, in regularly occurring contexts (Xu et al 2014). The use of Intensive Interaction throughout the data collection was twofold. Intensive Interaction was the primary form of

communication between Simeon and I and had become a well established part of our routine prior to the beginning of data collection, but it also served as a means to identify Simeon's assent to a recording session, and how likely he was to vocalise. Simeon's familiarity and confidence with Intensive Interaction and engaging in it with me was believed to be well established before the time of the study, as such it was considered unlikely for the practice to elicit any of the dramatic departures from his regular vocal behaviours Firth (2008) describes in the early stages of the practice.

Utterances were identified as vocalisations followed by a silence of 1.5 seconds. This was because Simeon would often vocalise in a purposely hoarse voice, and 1.5 seconds normally exceeded the time it took for his voice to reappear within a single vocalisation. Each utterance was isolated, analysed, and individually transcribed utilising IPA notation where possible, with the extension for disordered speech (ICPLA 2015). This aligns with previous studies which observed speechlike and non-speechlike vocal behaviours in prelinguistic communicators (Paul et al 2011; Ozonoff et al 2010), however the data was not processed into these two categories, and an attempt to phonetically transcribe all identified utterances was made. Utilising the IPA allowed for an accurate plotting of Simeon's tone, consonant, and vowel usage as well as the perceived structure of his syllables. This practice aligned with preceding investigations into developmental phonology (Paul et al, 2011; Schoen et al, 2011) where a set number of recorded utterances were subjected to transcription. However due to the nature of this study, and its sole focus on the phonological ability of one individual, no upper limit was placed on the number of transcribed utterances so as to provide as broad of an example of Simeon's vocal behaviours as possible. Once these transcriptions were completed, their constituent parts were quantified in order to measure the frequency of phoneme occurrence. The intention of this quantification was to measure Simeon's most commonly produced phonemes in the data as part of an observation of phonemic preference. A similar analysis of pitch contours was made. The prevalence of vowels was recorded and subjected to formant analysis (Joos 1948; Veatch 1991). Once collated, Simeon's phone inventory was compared to that of his home languages, in order to map the potential influence of English, Central Thai, and/or Isan. Likewise, a comparison was conducted with Simeon's use of pitch contours, and their similarities and differences to communicative usage in Central Thai, Isan and English. The formant plotting of Simeon's vowels saw each instance of vowel production mapped on a formant graph representing the articulatory position of each realisation.Simeon's vowel articulation was compared to the positioning of his parents' vowels. This was done by mapping the parents' articulations onto the

appropriate vowel graphs to observe any proximal vowel plots which would indicate a similarity in articulatory position between Simeon and his parents (Joos 1948; Veatch 1991).

The environments where Simeon produced specific phones were noted, described thoroughly, and compared to the syllable structures of English and Thai. Identifying the potential for structures in Simeon's vocal data required observing consistently similar, or repeating forms in the data. Special focus was taken in noting repeated, or seemingly favoured "phrases" and pitch contour patterns. The utterances were scrutinised for repetitions or similarities in syllable structure, in pitch contour, and in vowel placements. These repetitions were identified and loosely described in such a way as "solitary vowel articulation" or "idiosyncratic tone shifting" etc. These marked data were first observed quantitatively, by counting the number of instances they could be found, and then were observed critically so as to identify the "phrases" that appear in a number of instances that surpassed 5. This was the means by which Simeon's favoured utterance structures were identified.

Qualitative investigation of Simeon's favoured utterances took place by way of observing the phonetic structure of each marked phrase with the intention to identify commonalities which might give way to the formulation of phonotactic rules. This investigation involved the identification of vocalisations which appeared most frequently in the data, and then exploring the ways in which they remain phonetically similar - consisting of the same phonemes - and how they appear slightly differently but still appearing to hold to a similar structure. While a qualitative investigation into preferred or frequently found utterances may also be lent to the purpose of observing phonological influence, this practice occupied a secondary intention of the research which was to explore the nature or Simeon's utterances to observe any internal patterns, or characteristics that might be said to generally define his vocal behaviours. In a way similar to the phonotactic description designed to describe the patterns in Simeon's syllable structure, the observation of favoured utterances allows for a more nuanced, qualitative perspective on the seemingly novel utterances within the data.

Inclusivity

It is important that the research explains the inclusive positionality of this study. It is my understanding, and that of his family, that Simeon and I are friends, but at the very least the relationship can be described as a professional companionship. As a member of staff at the school Simeon previously attended, and a member of the congregation of a church he attended growing up he and I have known each other for over 15 years, in a number of contexts including the support role undertaken throughout the data collection. I was receiving payment from Simeon's parents for the hours I spent with him, as a personal assistant, aiding him to access the community. That being said, the times we spent together were largely recreational and focused around exploring ways to engage in the community safely and confidently. I believe the friendship that Simeon and I have developed was grounded in mutual respect, and understanding. This positionality is not confounding for the design of this research, but I believe it is paramount in the assurance of Simeon's safety, wellbeing, and active engagement in the research. This intention to make clear Simeon's agency in the research is born from the progressive movement toward more inclusive methods when it comes to conducting studies with minority groups (Nind 2014). Inclusivity in research is an aspect of method design that encourages researchers to reflect on their practice and observe the means by which it might be considered inclusive, and identifying the areas which could be improved upon (Nind 2014). Contemporary writing on the matter advises against treating inclusivity as a pass/fail binary, but instead recommends keeping record of inclusive aspects of one's method design (Walmsley and Johnson 2003; Nind 2014). As such, I believe this research can be described as inclusive for the following reasons:

- An investigation into the potential of phonological influence is in the interest of individuals with PMLD as this has the potential to shed greater light on their interactions with their social and linguistic environment rather than perpetuating the assumption that they are not linguistic entities
- The development of a rapport, and friendship with Simeon before initiating data collection, allowing for a "person first" approach to understanding his vocal behaviours, and communicating on his terms and by his preferred methods
- Minimising the amount of concentrated effort required by Simeon to actively participate by removing any expectation regarding the nature of his utterances, and providing consistent positive feedback for all vocal behaviours, recorded or unrecorded.

- Providing minimal impact on Simeon's routines, and remaining consistently critical regarding his behaviours, in order to recognise potential signs of anxiety or stress, and taking appropriate measures to prioritise his needs over the research.
- Adopting inclusive language such as the prepositional shift from "research on" to "research with" rhetoric.

Accessibility is often discussed in regards to indicators of inclusive research practices (Walmsley and Johnson 2003; Walmsley et al 2018). One challenge this research faced is making the research accessible to the people it represents. Due to the profound cognitive impairment frequently associated with the label of PMLD (Lacey 1988; Samuel and Pritchard 2001; Ware 2004; Hogg 2004), making research such as this entirely accessible is remarkably difficult. However the practice of Intensive Interaction is well known throughout PMLD pedagogy (Nind 1999; Hewett 2009), and the use of it as a means of eliciting nonverbal conversational data is to some degree accessible for those with profound cognitive impairments.

The adoption of an inclusive approach to practices such as phonological study may raise concerns around the terminology used, specifically the implications of the prepositional shift towards "research with" rather than "on" (Nind 2014) and the implications this may have for phonemic priming. Accent and phonological study classically avoids practice that may directly encourage participants to produce specific phonemes, and instead engineers environments where they may occur organically. Inclusive language such as collaboration, and "research with" has the potential to be misconstrued as evidence of essentially coaching the participant to make certain desired utterances. For this research, this is not the case, and to assuage this potential concern, the utilisation of Intensive Interaction dynamics may be reiterated. Simeon's utterances throughout the research were almost exclusively initial, and were met with either replication or positive comment, as part of a responsive and interactive social environment. This practice may give way to the repetition of certain utterances, in search of desirable responses. Repetition in this way while producing language may be confounding, as it may cause Simeon to alter his phonemic realisation of a phrase, but as Simeon is not producing language at any point in the data, the potential of this occurring is minimal.

Simeon's willingness to participate in data gathering was inferred from his behaviour on each day of recording. His cooperation with my direction in social/behavioural matters throughout the

day was taken as an indication of agreeability and wellbeing. It was in these states that Simeon responded most positively to Intensive Interaction. The data consists of 16 recordings of Intensive Interaction sessions with Simeon on the days where he appears the most agreeable and happy. Simeon has displayed challenging behaviours such as biting or pinching while I was working with him as a Personal Assistant. This was always read as a withdrawal of assent, and any sessions on days where Simeon appeared to demonstrate nervous or non-cooperative behaviours were not recorded.

Results and Discussion

This research is concerned with the vocal behaviours of Simeon, a young man who has occupied the prelinguistic stage of development (Keen et al 2016) long enough that his family do not expect him to begin to develop any further linguistic skills, and for this reason can be described as non-verbal. Many preceding studies (Maljaars et al 2011; Garrido et al 2017; Schoen et al 2011; Ozonoff et al 2011; Trembath et al 2019; Sheinkopf et al 2000) have observed preverbalism and non-verbalism as a developmental stage where a significant portion of people with ASC remain for an extended period. This study is not concerned with observing the features of the prelinguistic developmental stage, and in that way differs from many previous studies. Instead, this study looks to explore the vocal behaviours of a non-verbal person to verify the presence of potential linguistic influence. Phonological influence has been observed in children with ASC who have gone on to learn language, and has been identified as atypical (Baron-Cohen and Staunton 1994). This study measures Simeon's phonemic inventory in order to garner potential influence from his linguistic environment, but solely with the interest of describing his vocal behaviours and the potential relationship they might have with language, rather than how speechlike they might be. As such, this study begins to address a gap in the literature around prelinguistic study which intends to observe the patterns and forms of vocal behaviours, and how they appear to relate to the linguistic environment rather than how close a nonverbal person might be to acquiring productive language.

It is worth acknowledging that for this study there is great potential to fall into prescription and bias. With this in mind, I will attempt to ground my argumentation in this simple premise: regardless of whether Simeon is displaying any indication of linguistic influence or not, the nature of non-verbalism needs to be explored. The fact that there have been no preceding phonological investigations into non-verbal vocal behaviour provides the research with a unique opportunity to approach this matter without the potential bias of previous findings, or attitudes. On the other hand the apparent silence on this matter can lead this research towards grandiose statements of remarkable discovery, which may then lead to hyperbole and inaccuracy. Furthermore there is the potential that such a paucity in this particular area of research may simply be because there is nothing interesting to be said on the matter. Nonetheless, I will maintain the personal position that non-verbal vocalisations are an inherently interesting phenomenon, and that the results of this phonetic investigation verify this position

Vowel Usage

Vowel	number of utterances in which it is present	proportion of vowel usage
i	22	4.45%
y	63	12.75%
ɪ	26	5.26%
ʏ	17	3.44%
ø	17	3.44%
ɛ	20	4.05%
œ	14	2.83%
æ	7	1.42%
a	7	1.42%
ɐ	22	4.45%
ɜ	30	6.07%
ə	42	8.50%
ɵ	2	0.40%

ɵ	7	1.42%
ʉ	40	8.10%
u	8	1.62%
ʊ	10	2.02%
e	7	1.42%
o	37	7.49%
ɔ	4	0.81%
ʌ	61	12.35%
ɑ	4	0.81%
ɒ	1	0.20%
ɞ	1	0.20%
œ	24	4.86%

Vowels found in English (Wells 1982)

Vowels found in Isan & Thai (Tingsabadh and Abramson 1993)

Vowels found in both (Wells 1982; Tingsabadh and Abramson 1993)

fig 8

Quantity of Simeon's Vowels

Simeon's vowels were identified, collated and grouped by alignment with his home phonologies. Figure 8 displays all the vowels present in Simeon's utterances, both in isolated articulations, and with consonants. Discussion of any relationship these vowels have with their environment is had in the phonotactics section (Page 81). One may observe these vowels in the data and the amount of potential alignment with the phonologies Simeon is exposed to regularly. As such one

might observe that approximately 26% of Simeon's vowel utterances in the data also appear in the phonologies of Central and Isan Thai. One could also say that 58% of Simeon's vowel utterances contain vowels also found in South East English, while 29% of his vowel production do not align with any of his home language phonologies. In this way it seems that Simeon produces similar vowels to those found in South East English as a phonology.

[æ] and [a] were differentiated in the data, but recognised as potential realisations of the Trap vowel found in South East English for the purposes of measuring influence (Wells 1982). Similarly, [ɐ] was measured as a potential Isan/Thai influence on account of the central position the vowel tends to appear in spoken Thai (Tingsabadh and Abramson 1993). Similarly [ʉ] and [u] are treated as signs of influence on account variable realisations of the Goose vowel (Wells 1982).

Within the South East English vowels, Simeon produces [ʉ], [ə], [ʌ] the most frequently. [ə], [ʌ] are notable for their their neutral tongue position. It could be possible that these vowels may not always be conscious articulations, but instead vocalisations while the tongue is in a neutral, relaxed position. It is important to recognise this possibility, but at the same time recognise Simeon's ability to produce more vowel sounds such as [y] and [ʉ] as often as he appears to in the data, as these are far less likely to be incidentally produced.

Vowel Formant Analysis

Simeon's vowels were initially categorised by impressionistic analysis, and then later subjected to formant analysis similar to the works of Veatch (1991) and Joos (1948). This practice involves observing the spectrogram of each instance of vowel articulation, and noting the frequency of the first two formants. The first formant (F1 value) of a vowel's sound wave is inversely

proportional to the tongue height of its articulation, while the frequency of the second formant is directly indicative of the vowel's backness (Joos 1948; Veatch 1991). The vowel data was subjected to formant analysis, in order to identify any similarity in articulation between Simeon's vowels and those of his parents. A secondary function of this analysis was that it provided greater insight into Simeon's open mouth vocalisations, and how he articulates them. The entirety of Simeon's vowel data can be observed in figure 9.

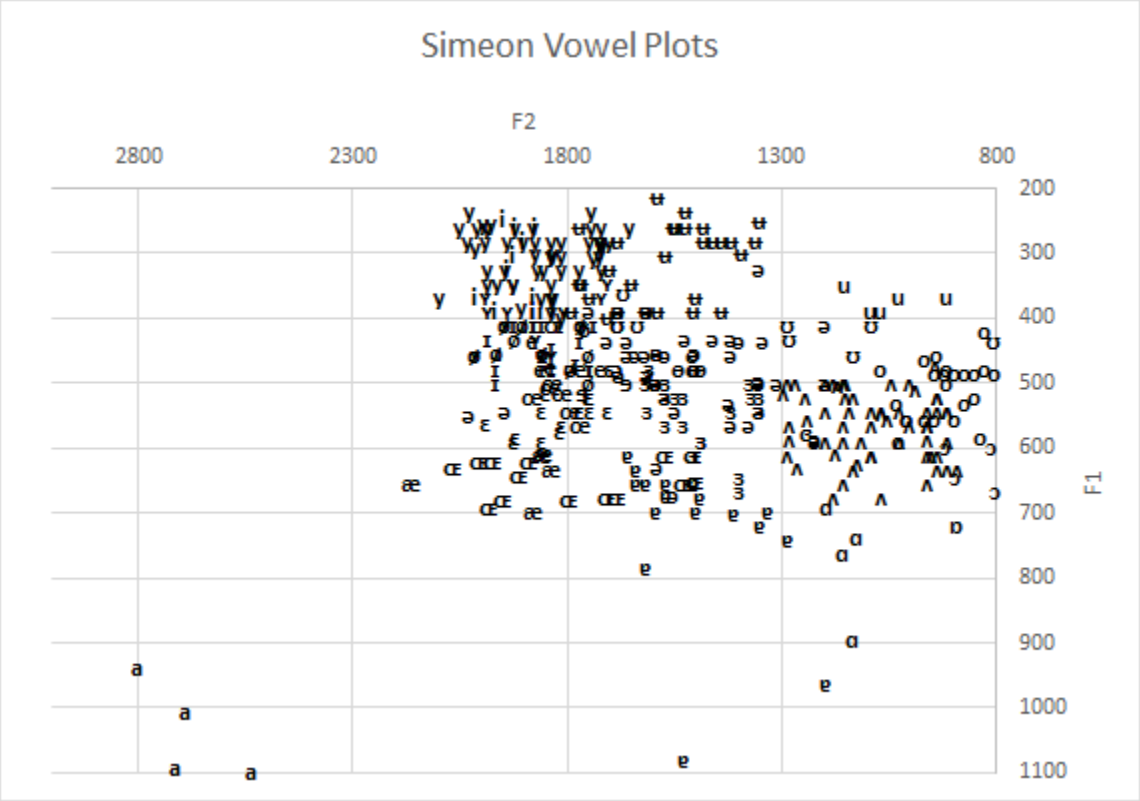

fig 9

Simeon's Vowel Plots

The axes of this graph could be modified to become more indicative of a conventional vowel quadrilateral, but to do so would be at the expense of all of the articulations of [a] and a number of other open vowels.

For clarity in discussion, a vowel specific graph is provided to indicate their positions more precisely.

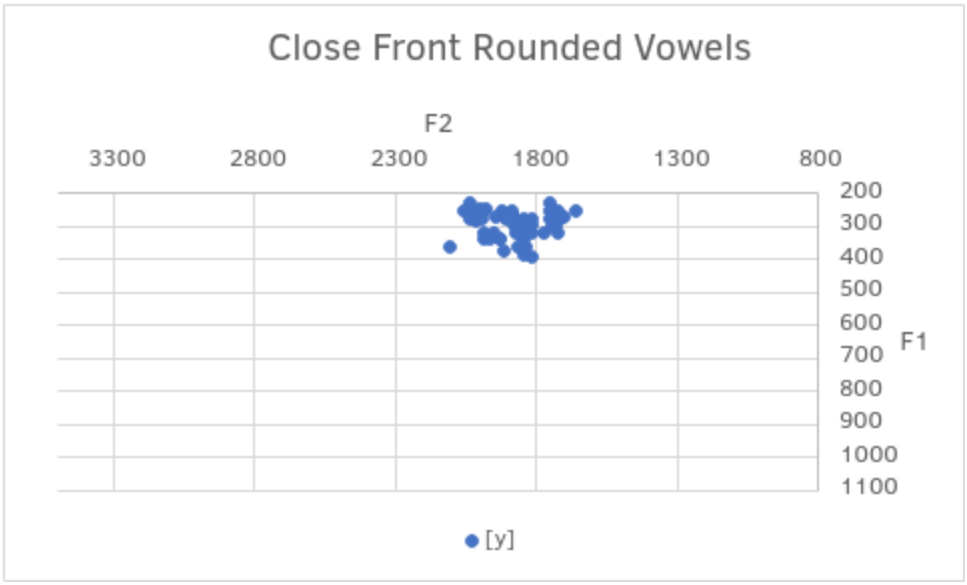

fig 10

Simeon's [y] plots

[y]

Simeon appears to produce a close front rounded vowel that has been transcribed as [y]. Simeon's realisations of [y] appear to have F1 values between 200-400, and F2 values between 1700-2100. Consequently this vowel appears to be consistently articulated in the close front position.

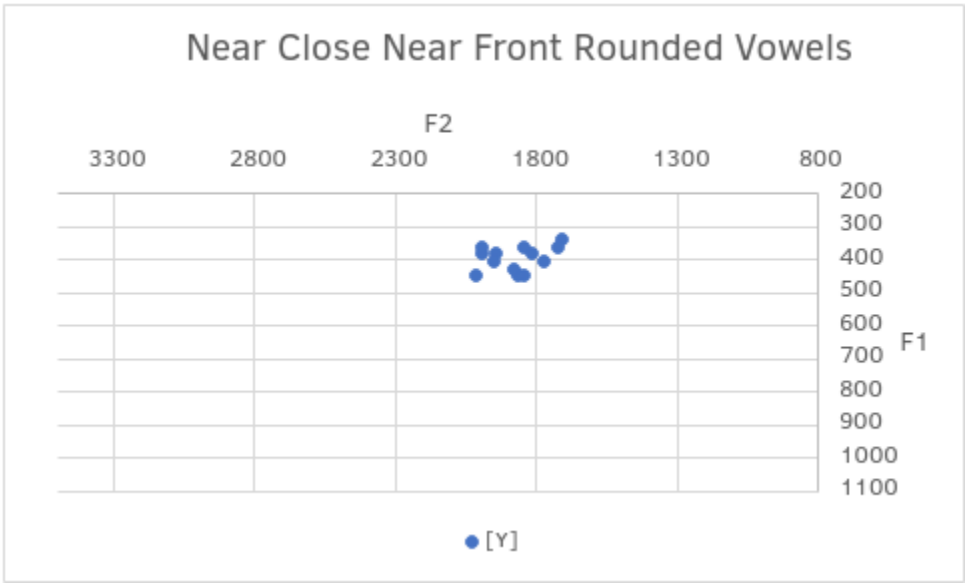

fig 11

Simeon's [Y] plots

[Y]

In a lower position than [y], Simeon appears to produce a near close near front rounded vowel that has been transcribed as [ʏ]. Simeon's realisations of [ʏ] were found to have F1 values between 300-500, and F2 values between 1700-2000. This sound was found to be audibly more open than Simeon's articulations of [y] as part of the impressionistic analysis which was then confirmed by the formants.

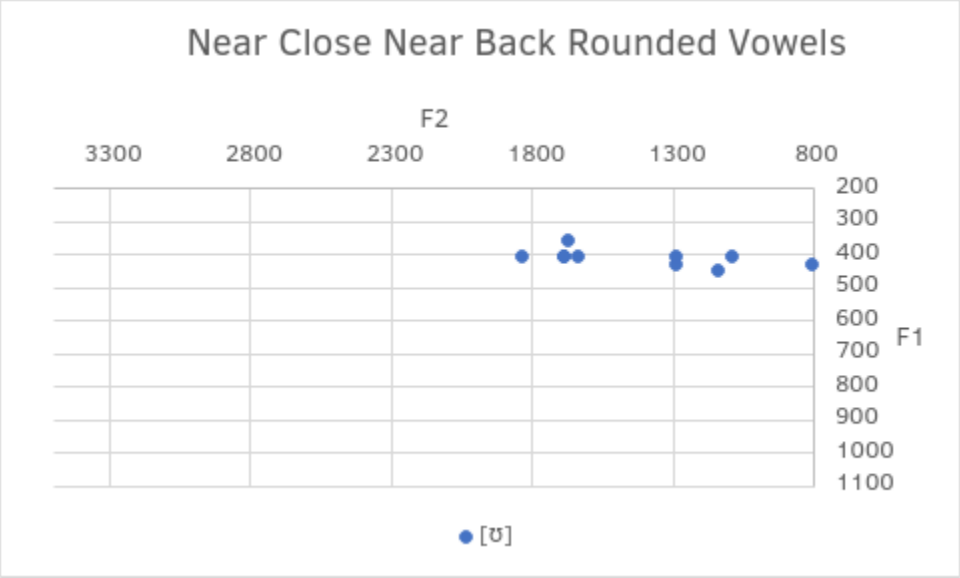

fig 12

Simeon's [ʊ] plots

[ʊ]

This sound appears to be audibly distinct in its openness from the surrounding rounded vowels, but does not appear with a consistent backness. Simeon's production of [ʊ] has a consistent F1 value range between 350-450, and an F2 value range between 800-1800. On account of its inconsistent backness, one could argue that Simeon's articulation of [ʊ] may be audibly distinct variations of [ʉ] and [u] but produced at in a lower position.

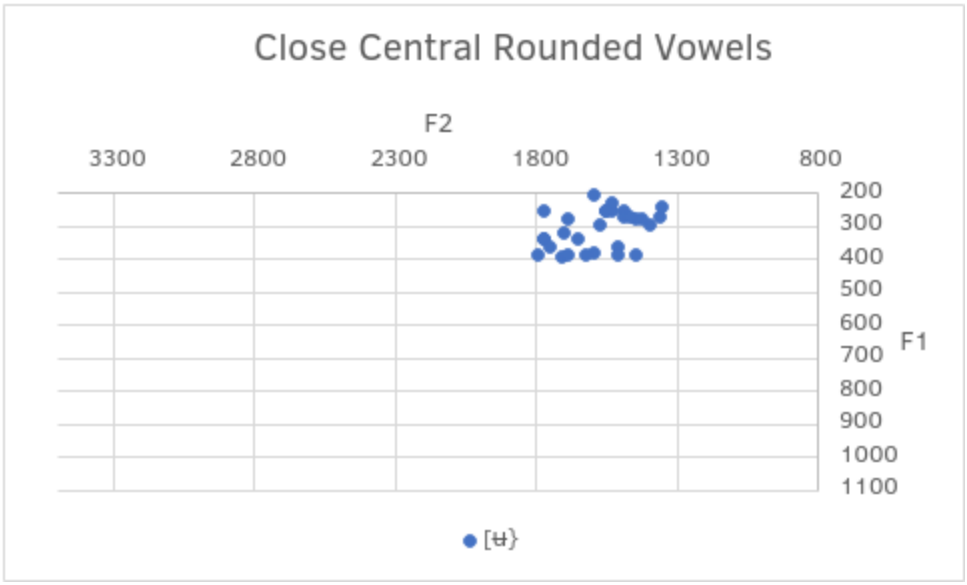

fig 13

Simeon's [ʉ] plots

[ʉ]

Simeon produces a close rounded vowel that appears to vary somewhat in backness. This has been transcribed as [ʉ] on account of its audible distinction from [y] as well as its comparatively central position. Simeon produces this sound with F1 values between 200-400, and with F2 values between 1400-1800. The F1 value places this vowel in a close or near close position, while the F2 values place it between the central and near front position.

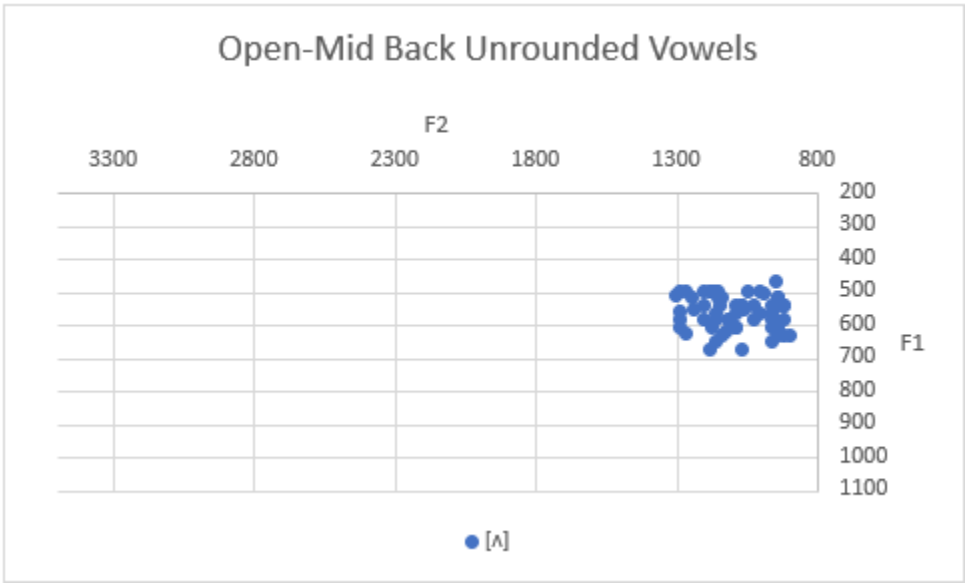

fig 14

Simeon's [ʌ] plots

[ʌ]

Simeon appears to produce an open-mid back unrounded vowel which was identified as [ʌ]. This vowel appears very often throughout the data and can be seen to be articulated quite consistently. Simeon appears to produce this vowel with F1 values between 480-700, and with F2 values between 900-1300. The ranges of these formants appear quite large, but due to the high concentration of [ʌ] in the data, Simeon appears to articulate the vowel across this range consistently. The lower articulations of [ʌ] in the data remain audibly distinct from the lower back unrounded vowel [ɑ]. Simeon's mother articulates [ʌ] with an F1 value of 520 and an F2 value of 1201, making it positionally very similar to Simeon's production of the vowel. As such we may observe an alignment in the production of [ʌ] between Simeon and his mother.

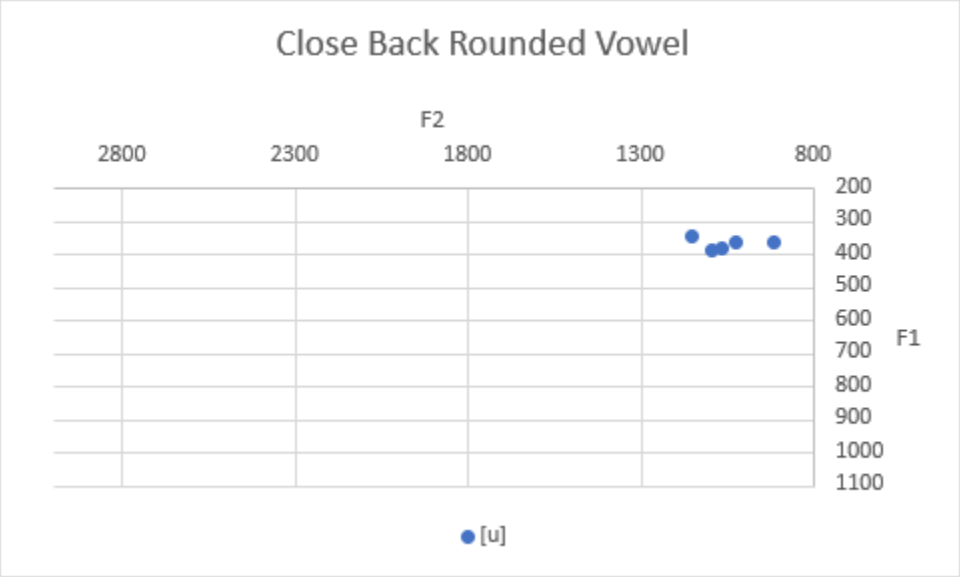

fig 15

Simeon's [u] plots

[u]

Simeon appears to produce a close back rounded vowel which has been transcribed as [u]. Simeon's [u] production is characterised by its close height and far back backness. Simeon's articulations of [u] appear to have F1 values around 350 and with F2 values between 900-1100. The articulatory positions of Simeon's [u] production aligns quite clearly with that of his parents, who both articulate the vowel with F1 values between 340-390 and with F2 values around 1000.

This indicates that Simeon's articulations of [u] align with that of his parents both in backness and in height.

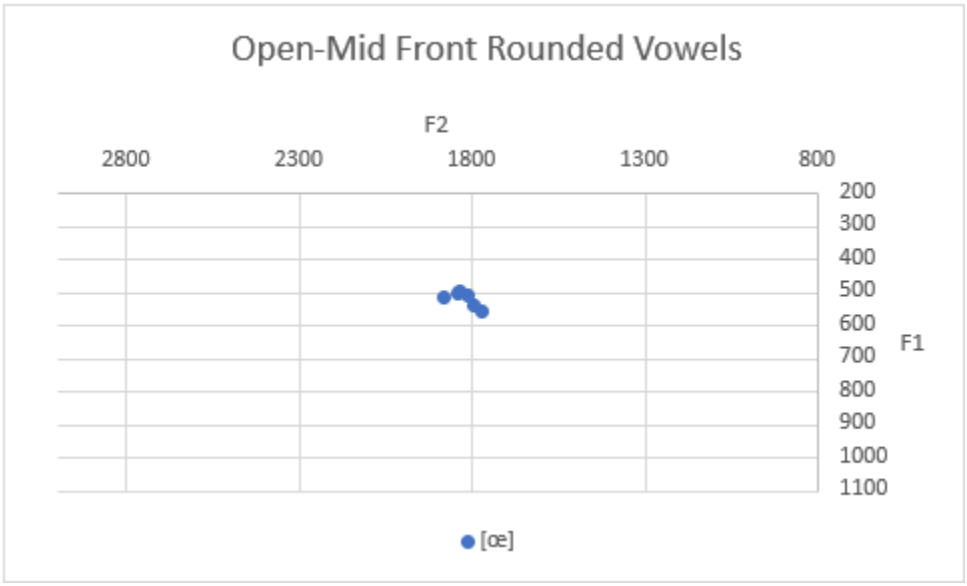

fig 16

Simeon's [œ] plots

[œ]

Simeon appears to produce an open-mid front rounded vowel, which has been transcribed as [œ]. Simeon's [œ] vocalisations are characterised by their relatively consistent open-mid height. Simeon's production of the open mid front rounded vowel appears to have F1 values between 490-570, and F2 values between 1750-1890.

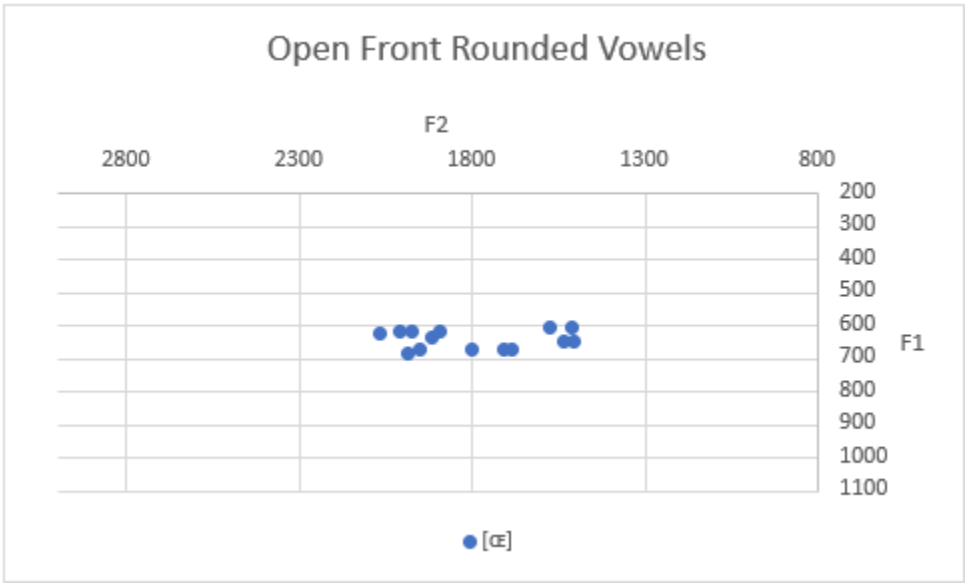

fig 17

Simeon's [œ] plots

[œ]

Simeon appeared to produce a vowel sound that was audibly distinct but did not have a consistent backness. This sound was transcribed as [œ] on account of its roundedness, and its openness as indicated by its consistently high F1 value. It is as a result of this vowels openness, and the fact that it appears rounded that it was transcribed as [œ], as there does not appear to be another sound quite like it. Simeons realisations of [œ] appear to have F1 values between 600-700, and F2 values between 1500-2100.

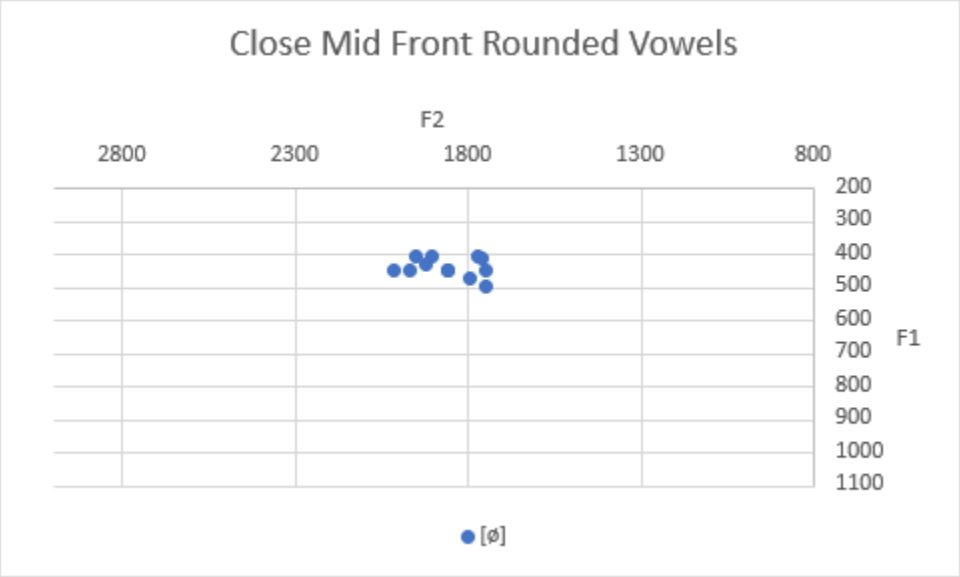

fig 18

Simeon's [ø] plots

[ø]

12 close-mid front rounded vowels were identified in the data and transcribed as [ø]. These sounds appear to occupy a close-mid position as indicated by their F1 values which were found to be between 430-500. The backness of these vowels is indicated by their F2 values (Joos 1948; Veatch 1991), which was found to be between 1700-2000, placing it in the front position.

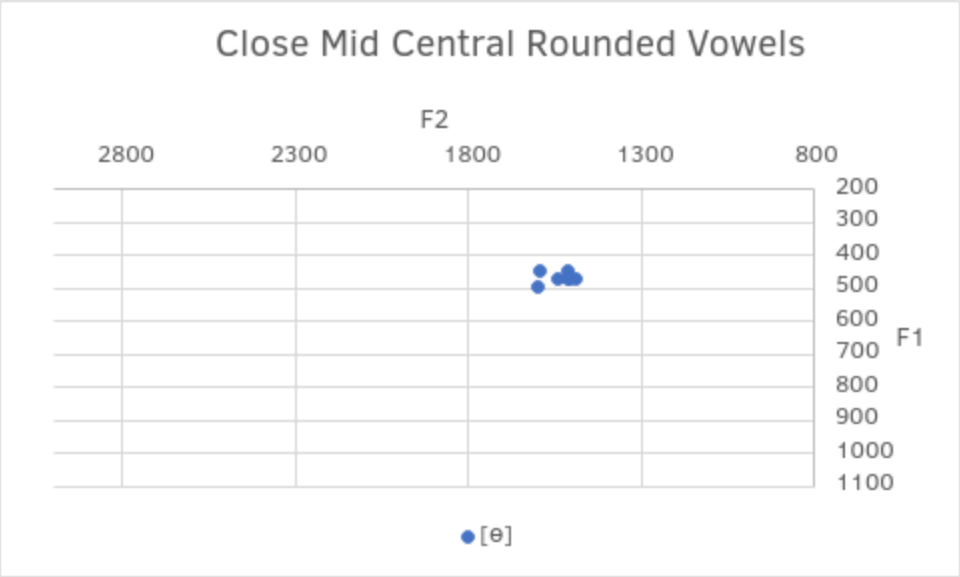

fig 19

Simeon's [ɵ] plots

[ɵ]

Simeon appears to produce close-mid central rounded vowels which have been transcribed as [ɵ]. Simeon's production of [ɵ] appears to be quite consistent, despite the relatively light presence in the data. Simeon's realisations of [ɵ] appear to have F1 values between 450-500 and F2 values between 1480-1600.

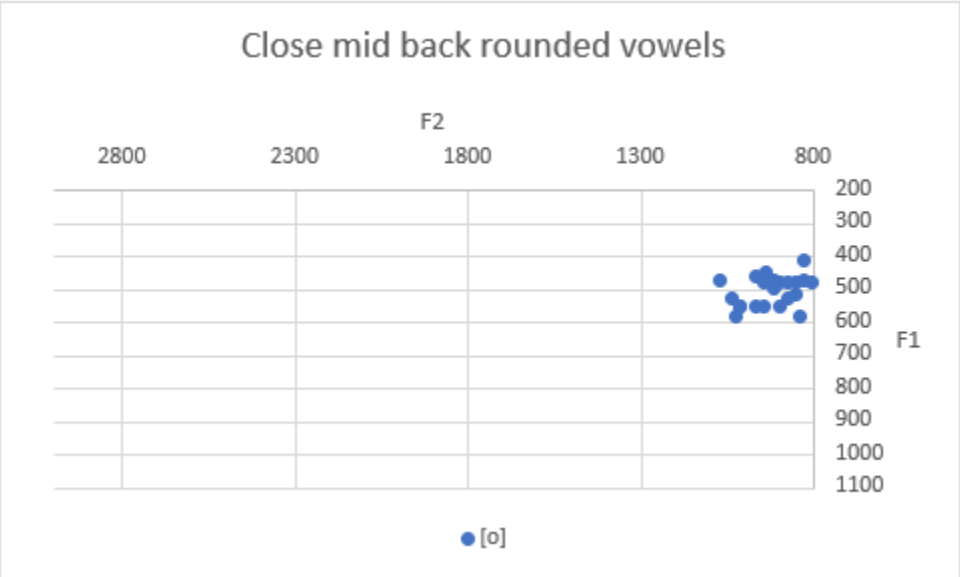

fig 20

Simeon's [o] plots

[o]

Simeon produces 30 instances of close-mid back rounded vowel sounds that have been transcribed as [o]. These phones are characterised by their far back articulations as displayed in their low F2 values (Joos 1948). Simeon appears to produce [o] with F1 values ranging between 400-600, and F2 values between 700-1100. The height of this vowel appears to vary quite broadly, but the sound appears audibly distinct from the open-mid rounded vowel [ɔ]. Simeon's father appears to produce [o] in a similar way, with an F1 value of 498 and an F2 value of 1025. The characteristic backness that was found in Simeon's production of [o] can also be found in his father's production of the vowel.

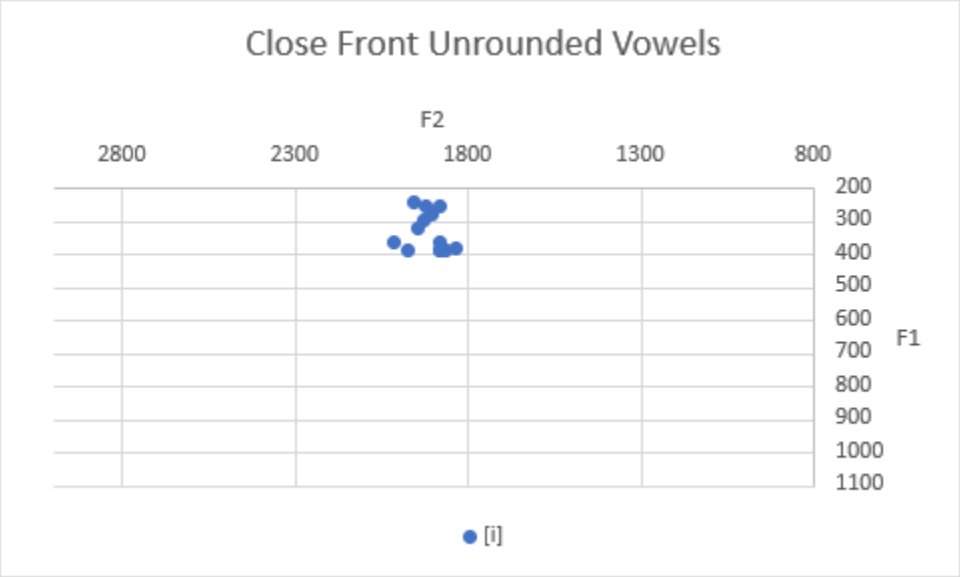

fig 21

Simeon's [i] plots

[i]

Simeon appears to produce a number of close front unrounded vowel phones, transcribed as [i]. The presence of this phone was determined on account of its clear audible distinction from the near close near front vowel [ɪ], and can be defined by its notably high tongue position. Simeon appears to produce [i] with F1 values between 230-390, and F2 values between 1800-2000. Simeon's parents both produce [i] in similarly high positions. Simeon's mother produces [i] with an F1 value of 390, and an F2 value of 1952, while his father produces the phone with an F1 value of 388 and an F2 value of 1793. This indicates that Simeon's articulations of [i] appear to align with the way his parents produce the sound, especially when considering the height with which they all appear to articulate the phone.

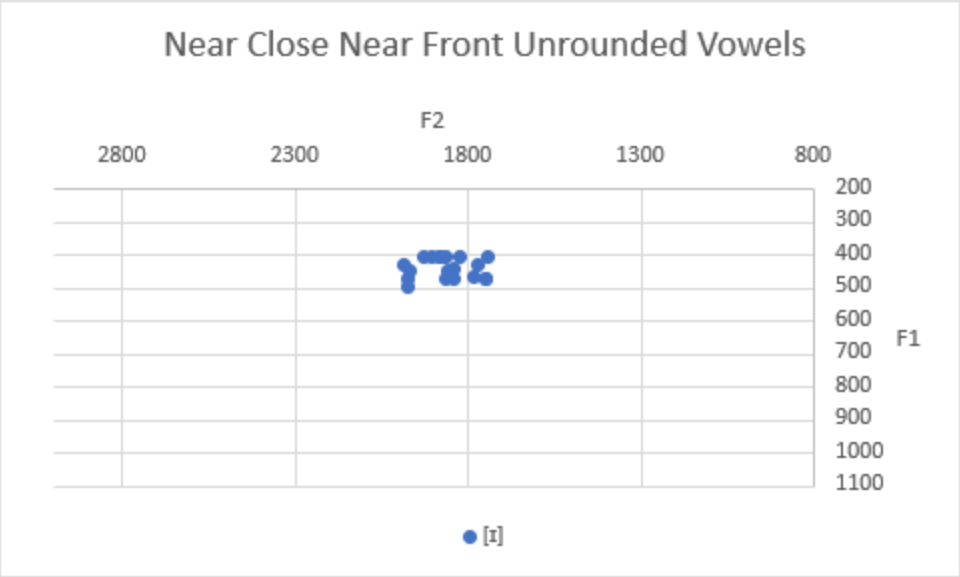

fig 22

Simeon's [ɪ] plots

[ɪ]

Simeon appears to produce near close near front unrounded vowels, that have been transcribed as [ɪ]. These vowels appeared to have F1 values between 400-500 and F2 values between 1700-1900. This places the vowel in a front position, but remains distinct from the higher front vowel [i] previously discussed. Furthermore an audible distinction was noted between [ɪ] and [i]. Simeon's mother produced [ɪ] with the F1 value of 415, and the F2 value of 1859, which appears to align with some of the higher articulations of Simeon's own articulations. In this way, one could say that Simeon occasionally appears to produce [ɪ] in a similar way to his mother.

[ɞ]

Only one articulation of the open-mid central rounded vowel was identified in the data, and appeared to have the F1 value of 575, and the F2 value of 1239. This indicates that this vowel may occupy more of a near back position, on account of its low F2 value (Joos 1948).

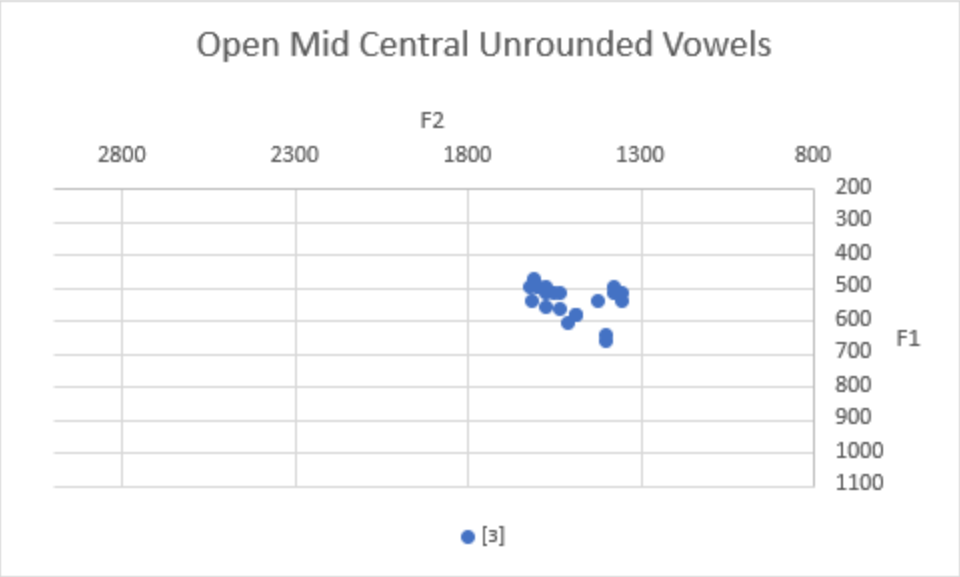

fig 23

Simeon's [ɜ] plots

[ɜ]

Articulations identified as [ɜ] can be found with F1 values between 490-650 and F2 values between 1350-1620. Simeon's realisation of [ɜ] appears to vary in backness, at times appearing to occupy more of a near back position than central. However this sound maintains audible distinction from the open-mid back unrounded vowel [ʌ]. Simeon's more central articulations appear quite similar to his mother's realisation of [ɜ]. Simeon's mother articulates this vowel with a F1 value of 586 and an F2 value of 1618. As such Simeon's articulations appear to align with the example of his mother's [ɜ] usage.

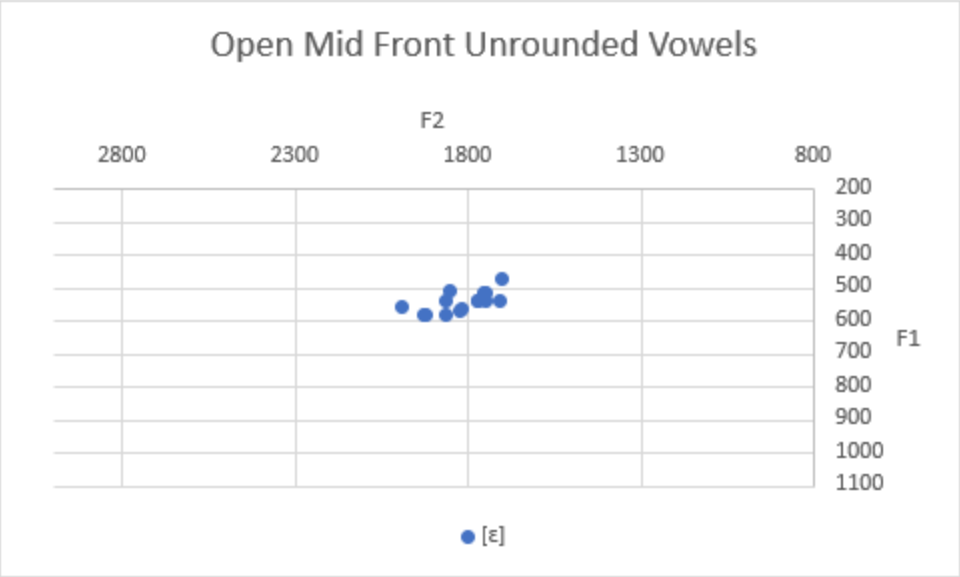

fig 24

Simeon's [ɛ] plots

[ɛ]

Simeon appears to produce a phone which aligns with the open-mid front unrounded vowel form. This phone was transcribed as [ɛ]. Simeon's realisations of [ɛ] were found to have F1 values between 450-600, and F2 values between 1700-2000. These formant values indicate that Simeon produces this phone in a consistently open-mid frontal position. The recordings of Simeon's father reading a Thai word list (Tingsabadh 1993) also include a realisation of [ɛ]. Simeon's father appeared to produce [ɛ] with an F1 value of 675 and an F2 value of 1755. This indicates that Simeon appears to produce [ɛ] in a slightly higher position than his father, but with a similar backness. Simeon's mother produces [ɛ] with an F1 value of 522 and an F2 value of 1864. As such one could also say that Simeon appears to articulate [ɛ] in a similar position to his mother at times.

[ə]

Two instances were identified in the data as central mid vowels, whilst still appearing audibly distinct from [ə]. These vowels were transcribed as [ə]. These utterances were found to have formant values of F1:498 F2:1662 and F1:513 F2:1762. These perceived occurrences of [ə] appear to share F1 values with several utterances of [ə], but maintain a slightly higher F2 indicating that these utterances may be an audible variation of [ə] articulation that was noticed during impressionistic analysis.

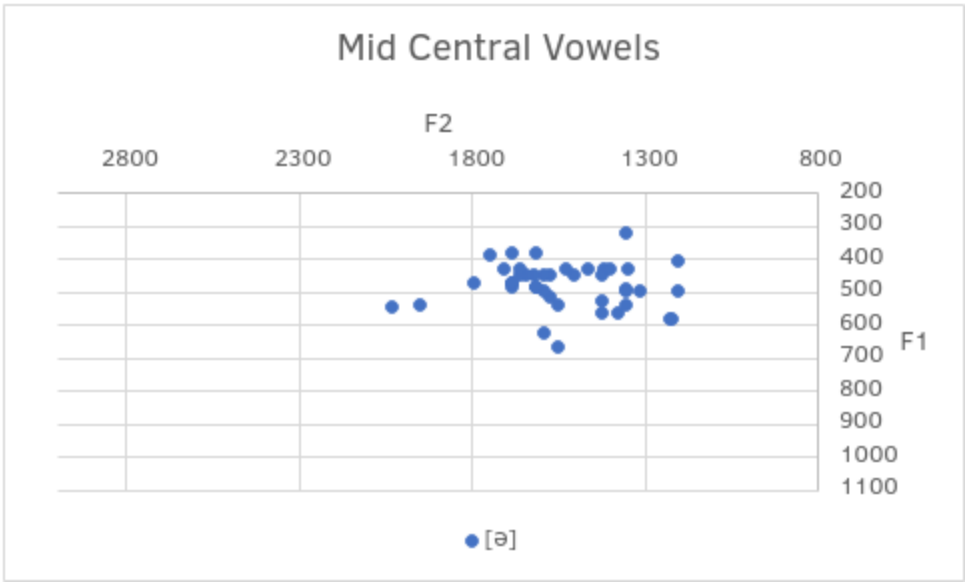

fig 25

Simeon's [ə] plots

[ə]

Simeon appears to vocalise often with his articulators in a mid central position. The instances of this occurring were transcribed as [ə]. The formant values of Simeon's [ə] articulations appear to vary greatly, but the highest concentration of mid central vowels appears to have F1 values between 450-600, and F2 values between 1400-1650. Consequently the backness of Simeon's [ə] realisations does not appear consistently, and can often be found in a near back position at the same height. However, this vowel was identified as distinct from the surrounding vowels as a result of impressionistic analysis.

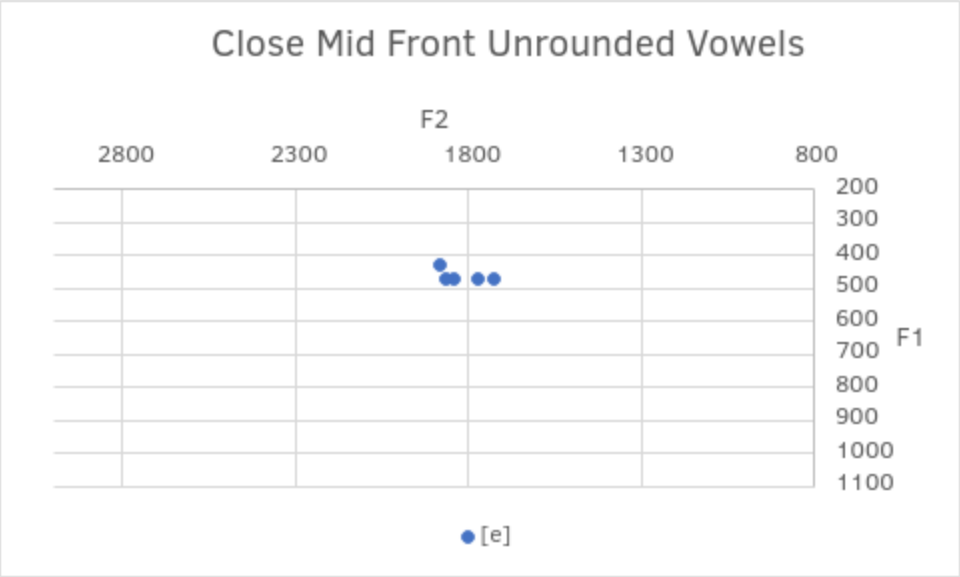

fig 26

Simeon's [e] plots

[e]

Simeon appears to produce a close mid front vowel that has been identified as [e]. The position of this vowel varies slightly in backness but maintains a consistent tongue height. The F1 value for this vowel is between 430-480, indicating a very consistently close mid tongue position. The backness of this vowel is indicated by the F2 values between 1720-1890. Simeon appears to produce this vowel very consistently despite appearing only 5 times. When comparing Simeon's articulation of [e] to that of his father's, we see that Simeon produces this sound in a slightly higher tongue position, but at a similar backness. Simeon's father produces [e] with the F1 value of 564 and with an F2 value of 1924. Consequently Simeon's close mid front unrounded vowels to be articulated in a similar way to the recording of his father producing [e] from a word list.

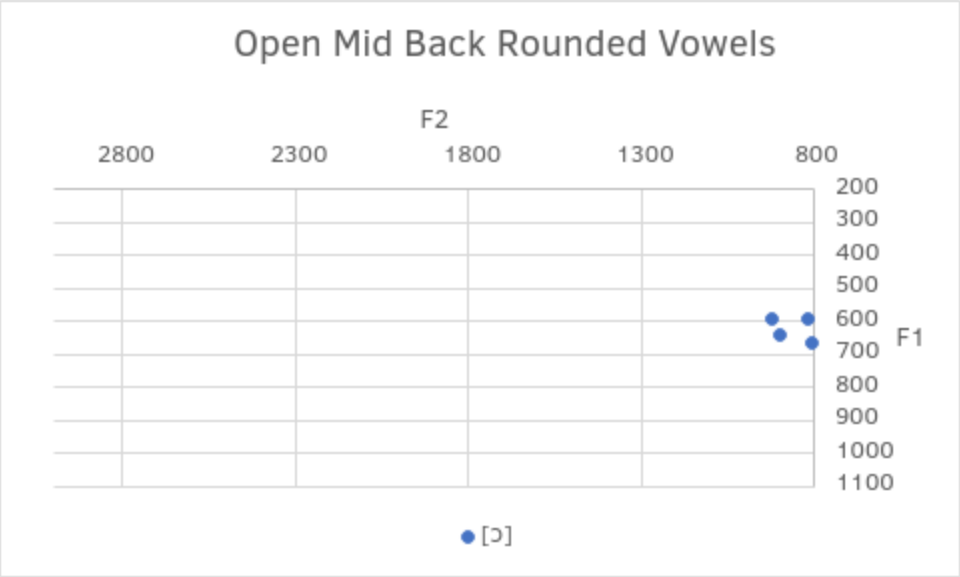

fig 27

Simeon's [ɔ] plots

[ɔ]

Four instances of open mid back rounded vowels were identified in the data, and noted as [ɔ]. Simeon appears to articulate this vowel quite consistently, with very little variation in formant values. These vowels were characterised by their open-mid tongue position as indicated by their F1 values between 590-670, and their far back backness as indicated by their low F2 values 800-920 (Joos 1948). There is a notable similarity between Simeon's articulation of [ɔ] and that of his mother, who produces the vowel with an F1 value of 588, and an F2 value of 1006. This indicates that Simeon's mother produces [ɔ] slightly higher and further forward in the mouth but still in a way that can be considered similar to Simeon's more forward articulations of the vowel.

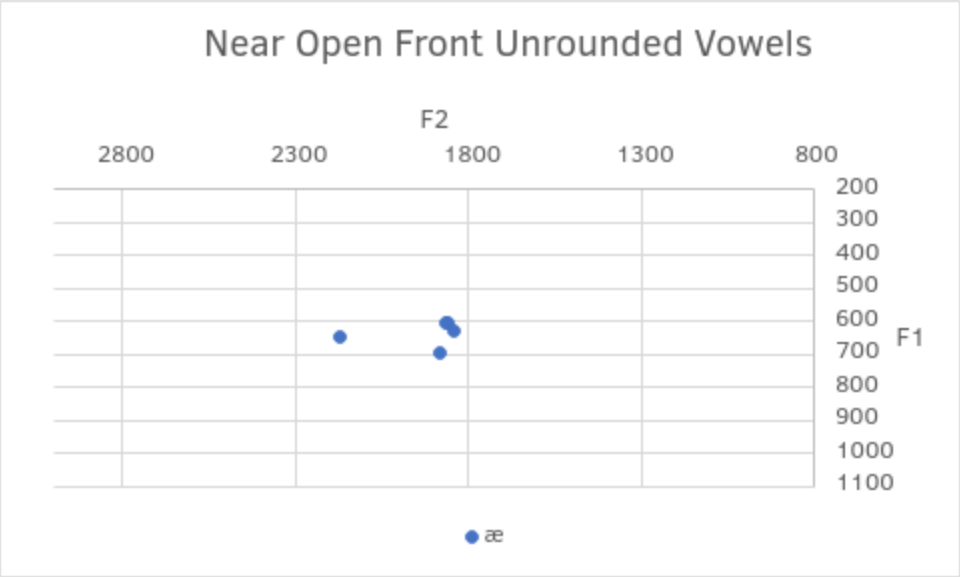

fig 28

Simeon's [æ] plots

[æ]

Four near open front unrounded vowels were found in the data, and labelled as [æ]. This vowel is characterised by its front position, with three occurrences occupying F2 values between 1800-1900, and the fourth occupying a further front position. All of the articulations of [æ] were found to have F1 values between 600-700. [æ] is identified in this context to provide clear distinction between these sounds and the further front, lower [a] vowels present in the data.

[ɒ]

The open back rounded vowel [ɒ] was identified once in the data. It occurs in a position markedly further back than the unrounded [ɑ] with the F1 value 716, and F2 value 891. The backness of this vowel aligns with Simeon's articulations of [o] and [ɔ], which may suggest that it is an isolated, open variation of one of the other two, more commonly found, rounded back vowels found in the data. Simeon's realisation of the open back rounded vowel is produced far further back than his mother's [ɒ] articulation, which has the similar F1 value of 786, but with a relatively more central F2 value of 1204.

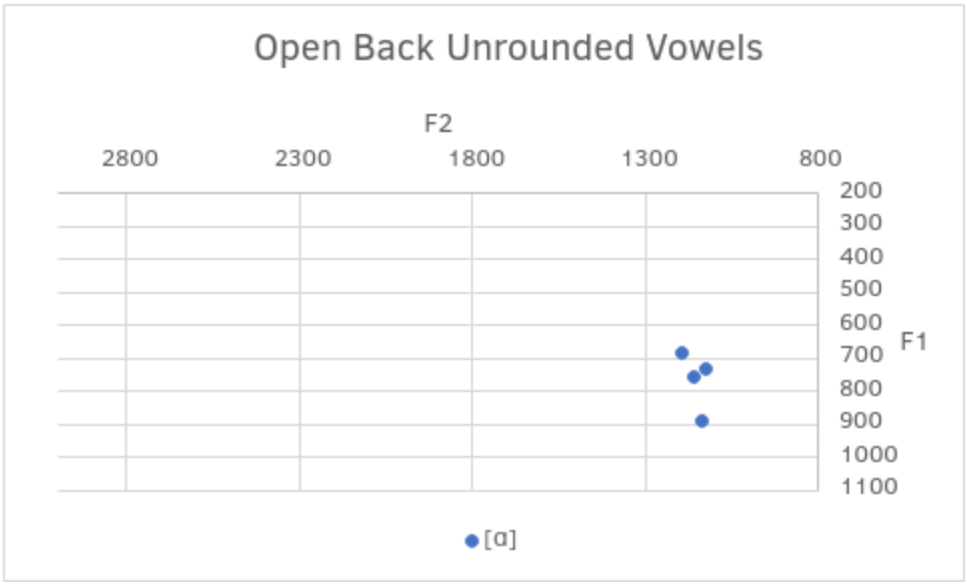

fig 29

Simeon's [ɑ] plots

[ɑ]

Simeon produces four instances of open back unrounded vowels in the data, which were identified as [ɑ]. These vowels were identified with F1 values between 680-900 indicating an open tongue placement, and with F2 values around 1100, indicating a back position (Joos 1948;Veatch 1991). The formant values of Simeon's articulations appear to align with that of his mother's reading of the word bath, which has the F1 value of 740, and the F2 value of 1069.

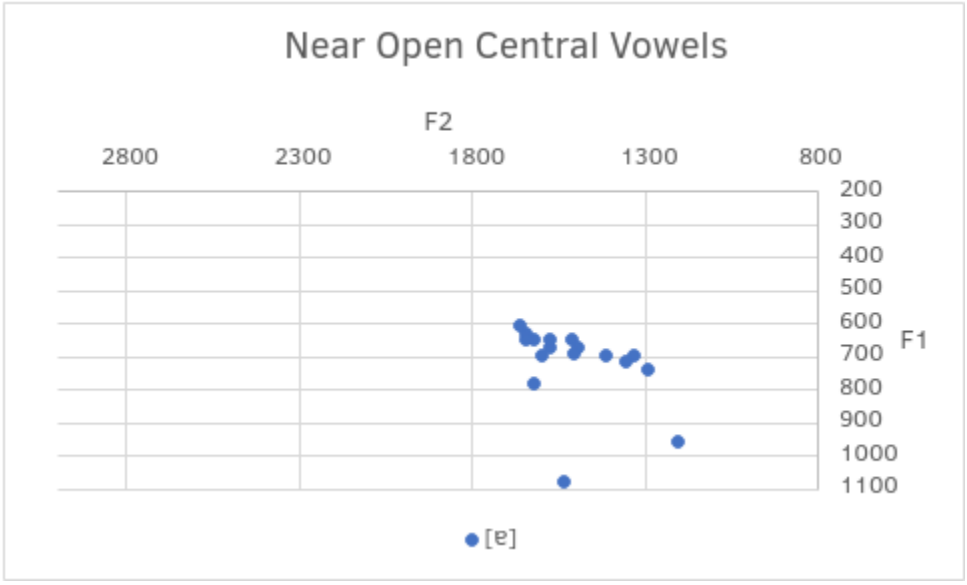

fig 30

Simeon's [ɐ] plots

[ɐ]

Simeon appears to produce a near open central sound that is identified as [ɐ]. This sound appears with F1 values predominantly between 600-700, and with F2 values around 1250-1650. Simeon's [ɐ] utterances appear in a position more central than his [a], but can appear in similar environments, such as [ɐm] instead of [am]. At other points in the data, [ɐ] was found in environments where [ɜ] is also found, such as [pɐʔ] instead of [pɜʔ]. This could indicate that the presence of [ɐ] in the data may have arisen from lower articulations of [ɜ] as well as potentially further back articulations of [a]. However [ɐ] is treated as a separate vowel on account of its distinct positionality indicated by the formants, as well as an audible distinction from both [ɜ] and [a], noted from impressionistic analysis.

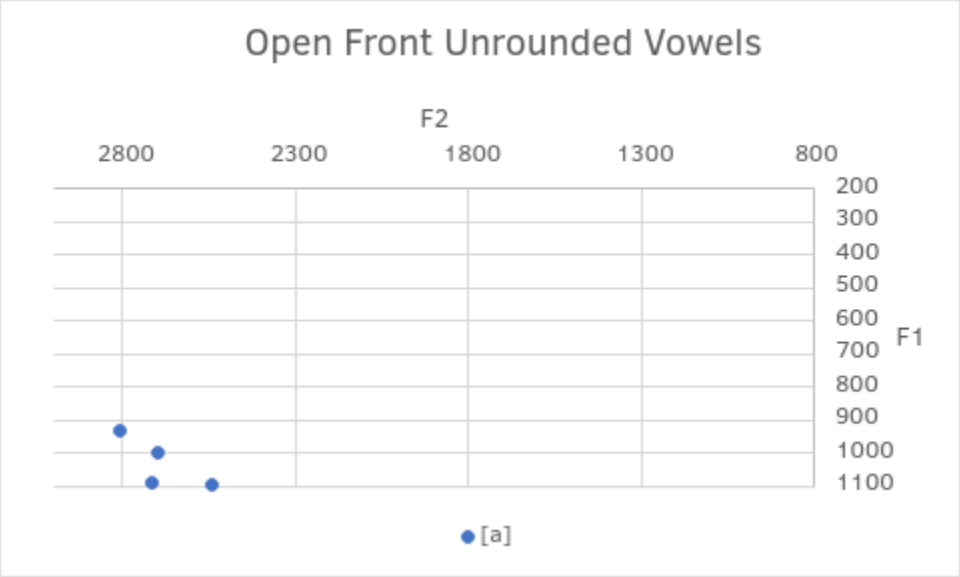

fig 31

Simeon's [a] plots

[a]

Simeon appears to produce a phone which can be described as the open front unrounded vowel [a]. This vowel appears to vary slightly in position, but can generally be found with high F1 and F2 values, indicating an open and front articulatory position (Joos 1948). Articulations of this phone can be noted for their F1 values ranging between 900-1100, indicating that Simeon's realisation of [a] approaches the maximum amount of openness possible in articulation (Joos 1948; Veach 1991). The backness of this vowel appears to occupy a far front position as a result of F2 values of 2500-2800. All of these articulations of [a] can be found in sections of the

data where Simeon appears to say [am] and nothing else. Simeon's articulation appears to bear very little resemblance to his father's realisation of the [a]. Instead, Simeon's father appears to produce [a] in more of a central position, with a F2 value of 1311 aligning with Tingsabadh's (2001) description of the open unrounded vowel's presence in Central Thai.

Summary

Simeon's realisations of the vowels [ʌ], [o], [u], [i], [ɪ], [ɜ], [ɛ], [e], [ɔ], and [ɑ] appear to align with the articulations his parents produced of vowels as read from word lists (Wells 1982; Tingsabadh and Abramson 1993). This alignment appears to occupy a large number of vowel articulations in the data. This could indicate that Simeon's vowel production is influenced by the vowels of his parents. It is through this close investigation of Simeon's vocal behaviours that one can begin to observe and describe phonological influence in his utterances beyond simply claiming that his vocalisations are "speech like" (Maljaars et al 2011; Garrido et al 2017).

Consonants

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Palatal	Velar	Glottal
Plosive	p b		t d				k	ʔ
Nasal	m			n				
Trill	ʙ							

Tap or Flap			ɾ						
Fricative	ɸ	β	f			ʃ	ʒ		h
Approximant					ɹ		j	w	
Lat. Approx.					l				

	Bilabial	Dental/ Alveolar	Palatal	Velar	Uvular
Voiced Implosives	ɓ			ɠ	

fig 32

Simeon's consonant table

As can be seen in figure 32, Simeon presents 40 distinct consonant phones, and 1 phone for raspberry blowing. In a measurement of influence Simeon's consonants were measured alongside the phonological inventories of English (Wells 1982), Thai (Slayden 2009), and Isan (Enfield 2007). A total was then accrued of consonants that appear: in both English, Thai/Isan - of which there are 16; in Thai/Isan and not English - of which there are 2; in English and not Thai - 2; and which appear in neither English Nor Thai - 20. In total, one can note that Simeon produces 20 consonant phones that can be associated with either Thai, English, or both phonologies.

Half of all the consonants in the data align with the consonant inventories of Isan, Thai, English, or both. This finding appears to support the argument that Simeon's speech is influenced by the languages found in his linguistic environment. One could also point to the fact that Simeon also produces 20 consonants which are not shared by English, Isan or Thai (Wells 1982; Slayden 2009; Enfield 2007). Nonetheless, Simeon appears to produce sounds that are in line with Isan,

Thai and/or English. This can be treated as evidence of linguistic influence on Simeon's vocal behaviours at some level.

The consonants that do not appear to be affiliated with Isan, Thai, or English phonologies (Enfield 2007;Wells, 1982; Slayden 2009) are as follows: [gⁿ], [kⁿ], [mʰ], [m̥], [ʙ], [ʙ̥], [g̠], [ɓ], [dˤ], [gʱ], [β], [bʰ], [ɾ], [n̥], [ǁ], [d̥], [ɸ], [ʒ], [ʔʰ], and [gⁿʰ]. Upon observation, we can see that 10 of these unaffiliated phones appear to be variations on sounds used in Isan, Thai or English (Wells 1982; Slayden 2009; Enfield 2007). Specifically the phones [gⁿ], [kⁿ], [gⁿʰ], [mʰ], [bʰ], [ʔʰ], [m̥], [n̥], [d̥], and [dˤ] appear to share similar foundational features as [g], [k], [m], [n], [b], [d], and [ʔ] but with differences around matters of voicing, aspiration, and engagement of otherwise unused articulators. Because the majority of these phones appear to only differ in one manner from phones that can be affiliated with Isan, Thai or English (Enfield 2007; Wells 1982; Slayden 2009) phonology. It can be argued that each of these variations lend themselves more towards the case of phonological influence than against.

Although sounding quite distinct, the positional differences in the transition towards nasal release forms of plosives such as [k] and [g] remain largely unmoved in terms of velar engagement and the forming of the plosive. Furthermore when observing Simeon's use of the nasal release velar plosives one could also take note of the presence of [k] and [g] with oral release in his consonant inventory. With this in mind, I would posit that the positional shift towards the nasal release of plosives is indicative of Simeon's relationship with nasals rather than any specific plosive. This notion is further supported by the fact that Simeon produces no nasal release plosive without also producing it with oral release elsewhere.

One can also note the presence of the nasal release alveolar plosive [dⁿ] which appears twice in the data and audibly presents very similarly to [gⁿ]. These were transcribed separately on account of position in utterances. Where [gⁿ] typically was found in contexts surrounded by bilabial nasals, it was difficult to approximate the position of Simeon's tongue, and so was purely noted on audible articulatory engagement whereas [dⁿ] can be found in two circumstances where tongue position was identifiable at the time of utterance. Also [dⁿ] was not included in the unaffiliated phonemes because of its presence in the South East English accent (Wells 1982). This is notable because Simeon may well have been articulating a sound closer to [dⁿ] than [gⁿ], but due to the bilabial engagement in the phonemic environment it was ambiguous.

The voiceless velar nasal release plosive [kⁿ] appears positionally very similar to [k], but in a similar closed mouth, nasal environment to [gⁿ]. Simeon is able to produce [k] in oral release environments, and though audibly distinct, the nasal release [kⁿ], displays no positional distinction other than bilabial closure. Consequently this may be indicative of Simeon exploring the ways in which he may be able to produce the velar plosive. Treating [kⁿ] as a potential signifier of influence is somewhat dubious, as the nasal release velar plosive does not appear anywhere in any of Simeon's potential influencer languages. However, if we observe the presence of the bilabial nasal as part of Simeon's personal phonetic preference (discussed on page 63) the fact that [k] appears in both oral and nasal release may be treated as the effect of linguistic influence.

One could say the variation of the voiced and voiceless forms appear to be somewhat random. However, when discussing the nature of the utterances in the data one must be aware of Simeon's agency. With this in mind, one could treat the variation between nasal release and oral release, voiced and unvoiced, as spontaneous exploration. Maintaining Grove's position of skepticism, prevents us from moving too far towards over-advocacy on Simeon's behalf, instead any potential interpretation of intentionality must be provided with consistent evidence (Grove et al. 1999). With no strong evidence of consistent intentionality in Simeon's utterances, the notion that he is purposefully experimenting with word sounds, may not truly be supported.

When pairing Simeon's use of voicing with his experiments in aspiration one might compare these instances in the data to the voice and aspiration rules of Thai (Iwasaki 2005). Thai's three way distinction between voiced, voiceless and aspirated plosives applies to three plosives [t], [k], and [p]. Simeon articulates each of the alveolar forms [t], [tʰ], and [d], and the bilabial forms [p], [pʰ], and [b]. Within the unaffiliated consonants, we also find [bʰ]. This indicates that Simeon is able to produce some phones in the three way distinction as outlined by Iwasaki (2005), but this does not appear in any organised alignment with Thai phonology. This may well be incidental or unintentional aspiration, much as how [b] might be articulated in languages which do not treat aspiration as distinct. While its existence in the data is interesting, the fact that it appears only twice in the data and not as often as [b], would indicate a likelihood that this is in fact not related to the three way distinction of voice and aspiration. Simeon does not present any identified instances of [kʰ] either.

[d̥] presents once in the data in a whispered repeated form that at other times in the data utilises [d]. Furthermore the voiceless notation was used because the [d] present appeared so aspirated as to not be voiced.

As such we might observe that of the 20 unaffiliated sounds, 10 of them appear to be closely related to phonemes found in Isan, Thai and/or English phonologies (Wells 1982; Slayden 2009; Enfield 2007). The nature of Simeon's explorative vocal behaviours lead us to the assertion that some facets of his experimentation might be influenced by his linguistic environment. One could ask if the assertion of linguistic influence on an individual who is primarily vocalising as a means of sensory exploration, is indicative that the speaker may well be demonstrating a path towards linguistic development. It is not in the interest of this research to say that non-verbal people are incapable of linguistic development, but there is the potential here to mistake the linguistic environment for growth. Evidently, Simeon's vocal explorations demonstrate some level of phonetic influence from his home languages, but that is not to say that it is a sign of language acquisition, so much as it is an appropriation of the sounds surrounding him. While in neurotypical linguistic development this may be considered a stage of babbling or protospeak, this stage is unlikely to hold the same implications of language acquisition in this context. Instead what can be said in respect to his vocalisations is that Simeon appears to have appropriated some word sounds he has heard growing up, and reproduces them as a means to meet a sensory need, or simply out of volition.

The remaining 10 unaffiliated sounds appear to be distinctly less organised. One might note a similar devoicing pattern with the bilabial trill, [ʙ] as can be seen with the alveolar plosive [d], as well as the voiced and unvoiced bilabial fricatives [ɸ] and [β]. Along with the bilabial implosive [ɓ], there appears to be a slight preference towards bilabial articulations. We can also see a nasal release velar implosive [ɠⁿ], as well as its oral release counterpart [ɠ]. We also see [ɾ], [ǁ], and [ʒ], the latter of which only appears in English as the africate /dʒ/ and not as a singular sound (Wells 1982).

If Simeon's vocalisations were truly random, we would expect more entirely novel and singular articulations such as the alveolar lateral click [ǁ] in the data. Instead Simeon only produces 10 sounds that can't be traced back to phonological influence. Simeon does not display an exploration of any more clicks in the data, or ejectives, or any other sounds that would be implacable when measuring Thai, Isan or English influence (Slayden 2009; Enfield 2007 Wells

1982). Aside from the raspberry blowing, Simeon provides very few cases at all of disordered speech features (ICPLA 2015). This indicates that Simeon may not be producing random sounds at will, and instead is demonstrating some level of influence in his vocalisations. These findings are integral to the case for non-verbal phonetic analysis. It is by these findings that we can say with confidence that Simeon appears to demonstrate a level of influence in his consonant inventory that aligns with the linguistic environment he has grown up in.

Accounting for Simeon's raspberry blowing, one could argue that the lack of any meaningful expectations placed upon him in regards to his vocalisations, may lead to a generally more phonetically playful environment in his interactions with support staff and peers. Raspberry blowing may well have occurred often in Simeon's educational experience, when engaging in intensive interaction, or possibly when overhearing peers. This is speculation, but remains a possibility which might potentially account for the phonologically unaffiliated sounds also. When accounting for these seemingly unaffiliated consonants it is important that the research recognises the importance of Simeon's environment and the potential for positive associations with sounds can account for occurrences such as raspberry blowing in the data. This proposition also aligns with the aforementioned recognition of Simeon's own intentions for vocalisation, specifically regarding the lack of external linguistic rules, or requirement for him to engage in any formal manner. If Simeon is entertained by raspberry blowing, then one can expect that he is likely to do so again, and with no prerequisite need to direct his vocalisations in any particular way - as one would when communicating with language - Simeon may be expected to blow raspberries as often as he would like to.

The volume of [m] in the data comprises 54% of Simeon's consonant usage. Presenting this as a matter of linguistic influence is not a sound position to hold when faced with such an overwhelming preference. However, when engaging in this matter, one might gain a more purposeful and descriptive insight by maintaining the same approach as was mentioned regarding Simeon's experiments with aspiration and raspberry blowing. Acknowledging the minimal rules with which Simeon engages, and the explorative play that is the primary cause of vocalisation. Seemingly chaotic findings such as this do not necessarily impair or impact upon any other findings when considering the lack of linguistic structure in Simeon's vocalisations. Instead when we account for Simeon's vocal play, and seemingly experimental vocal behaviours, we can simply acknowledge that this is a general preference of his.

To delve deeper into the idea of the Simeon vocal preferences, we can engage in discussion around the potential for popular or favoured phonemes to provide some specific level of sensory feedback when articulated. (Hyman et al 2020). One could interpret [m] in its high frequency as a means of meeting some level of sensory need that Simeon might have. Simeon can find it difficult to remain quiet for prolonged periods of time, and so this could also be an indication that he might need to vocalise to emotionally regulate and remain calm. The bilabial nasal is very easily articulated, and can provide a resonating sensation around the jaw and lips when produced, thus providing a very specific sensation for fairly minimal effort. It could also be that Simeon is not fully aware he is articulating [m] in every instance of it, which could potentially further embed the vocal behaviour as meeting a foundational regulatory need for him.

To perpetuate the criticism of this approach, one could argue that labelling [m] as a form of sensory seeking, and using that as an explanation for its presence in the data, is still excluding the phoneme from the results for being problematic. The response to this criticism is radically different to how conventional, linguistic development is discussed. The only response to this matter, in my mind, can be the acknowledgement of all of Simeon's vocal behaviours as forms of sensory seeking. As previously mentioned Simeon only vocalises socially when playing contingency games, and engaging in Intensive Interaction, neither of which require any level of necessity from him. Throughout the data Simeon is free to articulate - or not articulate - whatever he so desires, and it is in those vocalisations that he is exploring the sensations of the articulatory effort. If we are to approach any part of Simeon's phone inventory from the perspective of sensory feedback, we must acknowledge the reduction of all utterances in the data to the same level.

If one were to reduce Simeon's vocalisations to their most basic function: to fulfill his own articulatory curiosity in experimentation, one might ask what this changes of the research. The answer is nothing, functionally Simeon would still be producing phones that may be attributed to his perceived linguistic influences. Simeon has never used and has never been expected to use speech to communicate, and so the vocalisations were only ever consigned to recreational use, such as games and intensive interaction. Meanwhile the volume of [m] in the data ceases to be a problem, and instead becomes indicative of meeting a specific sensory need, much as any other phone. Consequently what can be said about Simeon's relationship with [m] is that it may simply provide the most favoured sensory feedback. The treatment of [m] as a phone, rather

than humming and excluding it from the data is a further departure from speechlike and non-speechlike dichotomy of preceding clinical research on the matter of linguistic development (Maljaars et al 2011; Garrido et al 2017; Paul et al 2011). The departure from the position of the preceding literature, allows for a more meaningful description of Simeon's vocal behaviours and sheds greater insight into their purpose without the inherent expectation of linguistic development.

Phonotactics

While we may adopt an understanding of Simeon's phone usage as a matter of sensory exploration, and vocal play, his construction of syllables appears to adhere to a slight uniformity. According to Spencer (1996), a syllable can be defined as a segment of a word that consists of an onset and rhyme. The onset of a syllable is a single phone, and the rhyme consists of a nucleus - typically a vowel - and a coda (Spencer 1996). When considering this definition we must observe the fact that Simeon is not producing words, and so the notion of his vocalisations including word segments is unlikely. However, an investigation into whether or not Simeon's utterances include similar onset and rhyme structures to those of his home languages may still continue.

In the observation of phonotactic rules, one may find that Simeon often uses nasals as nuclei of syllables. Whereas one might expect to see a vowel in English or Thai speech, Simeon's utterances appear to present [m] as a syllable nucleus, while occasionally producing plosive sounds - often with nasal release - at the onset and coda. For example the utterance [hm̀kⁿ] (1:67 in data) can be seen to present the glottal fricative [h] in the onset, the bilabial nasal [m] in the nucleus, and the nasal release velar plosive [kⁿ] in coda position. More cases of this placement of [m] can be found in extracts from the data where we see: the same form but repeated twice [hm̃kⁿḿkⁿḿ↗] (1:70); a similar circumstance but this time with a nasal release on the voiced velar plosive [m̃gⁿm̌gⁿm̃] (5:24); a placement between the nasal release alveolar plosive [dⁿm̃dⁿdⁿ] (5:35). These are the environments where Simeon appears to produce [m] in closed syllables. Simeon often produces utterances that are solely [m], such as [m̌] (4:34), and is able to produce utterances of multiple syllables solely comprising the bilabial nasal [m̃.ḿ]

(5:4), [m̃.m̃.m̃] (7:24), and [m̀ m̃ m̃ ḿ ḿ↗ m̂] (9:26) to name a few. As previously acknowledged in the discussion around Simeon's consonant inventory, the presence of the bilabial nasal in the data is especially high and his use of [m] in the syllable nucleus position appears to reflect this.

Simeon does not solely use [m] as a syllable nucleus, and demonstrates a use of vowels in the conventional syllabic position, as well. [dˤɪkədˤək] (9:37) is an example of a common form the participant produces, along with [dʊgədugədugədʊgədʊg] (3:17). One might notice that these two utterances differ only slightly in vowel position and plosive voicing. These two utterances are variants on a form that appears frequently in the data, often to elicit repetition, or a specific response from a friend, or supporting staff member. Other examples of this particular utterance may be found in [dʊgədʊgədʊgədə] (12:17), [dɪkədig] (12:12), [dʊgədəg] (9:68), and [dʊgədʊgədʊgədʊgədɤ] (9:95). The many instances of this particular utterance are prime examples of the participant using vowels in the syllable nucleus position. The presentation is elementary, either [ɪ] or [ʊ] occupies the nucleus of the first syllable, preceded by the voiced alveolar plosive [d] in the onset position, and in the coda position we find either a voiced or unvoiced alveolar plosive. To dissect these utterances further, the second syllable's nucleus is [ə], with the onset of the previous syllable's velar plosive, and the coda being the voiced alveolar plosive [d]. The phrase then repeats, and can vary slightly in the final syllable.

Phonotactic Formula

$$(O^{(N)})S^{(T)}(O^{(N)})$$

O = Obstruent
S = Sonorant
T = Tone
N= Nasal release

One could argue that the participant's syllable structure is quite similar to the $(C)^3V(C)^5$ (Crystal, 2003) formation of conventional English syllable environment, only with greater restrictions around the onset and coda consonants, and a greater lenience around the nucleus. However, the participant's placement of the nasals bilabial, alveolar, and velaric is so singularly unique

and independent of his language environment as to speak against any meaningful influence. Furthermore, one has to question whether it is possible to produce a syllable without a sonorant sound as a nucleus. In this respect , the phonotactic formula above is perhaps the simplest, and most agreeable that it could be.

Simeon's consonant clusters are often utilising nasals in syllables such as [ŋgagⁿ] (14:20), and [m̃ŋgⁿ] (13:52), along with many more instances of nasal release plosives adjacent to nasal sounds throughout the data. Four consonant clusters may be found that do not include nasal phonemes, these comprise [tɸtɸ] (5:28), [gwə̄] (10:45), [tkʰtkʰtk tkʰt] (15:19), and [dɪgdɪg ʌɓ] (15:35). One might note that of these four consonant clusters, two of them carry a sonorant consonant in the syllable nucleus placement. Beyond the two remaining instances of obstruent clustering (15:19, 15:35), Simeon only appears to cluster with sonorant consonants. This finding along with the presence of nasal phonemes in the syllable nucleus position gives ground to the $(O^{(N)})S^{(T)}(O^{(N)})$ formula, and further cements the theory that the participant uses sonorant sounds the way vowels appear in Thai or English, and obstruent consonants appear to occupy the positioning of typical consonants.

In the formulation of phonotactic rules around Simeon's vocalizations, one has to be careful to avoid the trap of over-advocacy. There is a temptation to make generalisations around Simeon's usage of the nasals [m], [n], and [ŋ] that might fail to accurately describe his vocal behaviours. For example one could draw the conclusion that Simeon treats the bilabial nasal as a vowel, and adjust all phonotactic investigation to account for the notion, and then be able to claim that in fact the participant tends to form syllables in a way very similar to the English $(C)^3V(C)^5$ (Crystal, 2003). Such an argument presents an attitude which is at odds with this study. While it is clear within the data that Simeon's use of [m] and other nasals in syllable nucleus position indicate a similar occupation as vowels in Isan, Thai, and English (Enfield 2007; Tingsabadh and Abramson 1993; Crystal 2003), to say that therefore these nasals may be treated as vowels appears to excuse a feature of Simeon's vocalisations in order to construct a narrative of allophonic variation. Doing so would involve altering the definition of speech, to then describe Simeon's vocal behaviours as speechlike. If we take this idea of allophonic variation further, we might begin to associate a level of consistency and form patterns around Simeon's vocal behaviours that solely exists on the acceptance of the fragile premise that essentially all nasals are vowels. Doing so is unnecessary at best, and runs the risk of implying that Simeon's utterances may be something like speech. As previously mentioned, Simeon's vocalisations are

considered arbitrary for the purpose of this investigation, and as such the concept of allophones, and variation thereof is a phonological nuance which cannot apply to his vocal behaviours.

These apparent rules do, however, indicate a level of complexity to Simeon's vocal behaviours that appears somewhat consistently. In the interest of remaining tentative however, we must entertain the notion that the rule structure $(O^{(N)})S^{(T)}(O^{(N)})$ has been reduced to the point of being almost inescapable. In other words, one could ask, is it possible for anyone to produce a syllable without adhering to this structure? A critique of this structure on the whole is that it is too simple as to be falsifiable, a syllable will always have a structure very similar to this, but to my mind it is not the most simple it could be. One could imagine a hypothetical nonverbal individual producing solely sonorant sounds, with no intention of replicating obstruent phones. In fact, one of the features of non-verbal autism (Hyman et al 2020) is their relationship with sonorant sounds as nasals and vowels, so it is possible that one could produce a syllable consisting of a single sonorant sound. Furthermore the previously stated relationship Simeon has with the sonorant bilabial nasal [m], implies that it is not beyond the realms of possibility that he could have been, in a stage in his life where he only produced singular, unaccompanied sonorant sounds in his vocal behaviour. Consequently the phonotactic rule structure $(O^{(N)})S^{(T)}(O^{(N)})$ stands as adequate for this purpose.

Observing and formulating phonotactic rules from the data leads to a place very similar to what was found in the vowel formant analysis, and also in the consonant inventory. Once again, we are in a position whereby Simeon demonstrates aptitude in the production of phonemes in an organised and consistent way, but is displaying no developing signs of language acquisition. One could claim that Simeon's vocal behaviour is similar in places to that of the linguistic structures of the languages that surround him. One could argue that the phonotactics of Simeon's vocal behaviour is fundamentally similar to the syllable structure of English, but for the use frequent use of nasals in nucleus position which in turn forces the description of the nucleus position to include all sonorant sounds rather than just vowels. At no juncture are Simeon's vocalisations considered to be language in any productive or meaningful way, but the foundational similarities, and patterns that consistently appear in the data at this stage become very difficult to ignore.

At this stage we see that Simeon demonstrates a similar phonemic inventory to the languages of his linguistic environment, but is able to produce syllables in a way that is distinct from them. As such we can see a phenomenon that does not appear to abide by the speechlike and non-speechlike dichotomy of previous studies which typically refer to a phonological similarity to language (Maljaars et al 2011; Garrido et al 2017; Paul et al 2011; Oller et al 1999). Instead we see that Simeon does appear to produce speech-like sounds but can do so in non-speechlike ways.

Pitch Contours

Tone	number of utterances containing	%
Falling	134	12.36%
Mid	298	27.49%
Rising	181	16.70%
High Rising	23	2.12%
Low Rising	11	1.01%
High	221	20.39%
Low	56	5.17%
Extra High	64	5.90%
Extra Low	3	0.28%
Rising-Falling	93	8.58%
total number of tones	1084	

fig 33

Quantity of Simeon's Pitch Contours

Pitch contours were identified impressionistically, comparing the shifting patterns Simeon produces with auditory examples of tones and contours included in the IPA (University of Victoria Accessed 2019) and can be found in figure 33. The research also received assistance from Simeon's father in the identification of Thai pitch contours within the data. Simeon's father described the pitch contours present in the data as somewhat similar to that of Thai, but distinctly more abrupt, or staccato in nature. Simeon's pitch contours were noted using the tone diacritics of the IPA (University of Victoria Accessed 2019), as found in figure 34

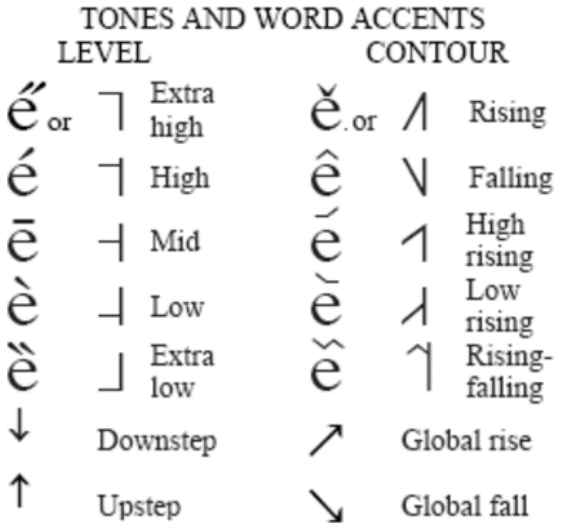

fig 34

Tones and Word Accents key

(University of Victoria Accessed 2019)

93% of the data were found to present pitch contours. The data indicates a strong preference towards the inclusion of pitch contours in Simeon's vocal play. Simeon appears to produce a pitch contour which aligns with mid tone most frequently, accounting for 27% of his tone usage. The second most commonly found pitch contour aligns with the high tone, accounting for 20%. The defining characteristics of these contours are quite different from one another, in that the mid tone is a single consistent pitch, while the high tone is articulated by rising from a low pitch to a high pitch. Rising contours are the third most commonly found pitch contours in the data, appearing 16% of Simeon's pitch shifting. Once again one might notice that the rising contour is not desperately similar to the mid, or high tones. Instead the rising tone is articulated by initially dropping from a neutral pitch to a low pitch, and then rising either to a neutral pitch again or perhaps higher. Falling pitch contours appear in the data also, and can be described as the inverse contour pattern to rising. This contour pattern occupies 12% of the pitch shifting data. The rising-falling pattern comprises 9% of Simeon's pitch shifting while utterances with low pitch contours - which begin from a high or neutral pitch, and ends in a low pitch - occupy 5%.

There are three distinct pitch contouring patterns which appear to be most commonly found in the data, while the contours that appear related in pattern or structure are not found in similar

numbers. Instead the data holds a sporadic distribution of pitch contours, that do not immediately display any kind of trend. This could indicate a number of possibilities regarding how Simeon engages with pitch contours in his vocalisations. One possibility is that Simeon has no specific pitch contouring preference, and as such utilises pitch shifting in his utterances out of impulse, and with no predominant reason. This is not unlikely as the frequency of the mid, high, and rising contours in the data appear in similar numbers despite distinct articulatory differences between each of them. One could attempt to argue the opposite, and claim that the three most frequently found pitch contours do make up a majority, and therefore indicate a preference in production. However, there is no real reason to group these three contours other than to form such a statistical majority for the sake of the argument. A third possibility could be that Simeon is echoing, or repeating pitch contours that he has heard from his environment, reproducing them at random.

This theory of seemingly impulsive or random pitch contouring gains traction when considering Simeon's identity as someone with autism. As part of Simeon's autism diagnosis, he is known to exhibit behaviours that provide very specific sensations known as self stimulating or "stimming" (Hyman et al 2020; American Psychiatric Association, 2013). In this way, Simeon's pitch shifting behaviours may be entirely dependent on his own sensory desires which may not be consistent. This notion of receiving sensory feedback becomes more credible when observing incidental vocal behaviours in the data that one could describe as musical.

Furthering the theory that Simeon's relationship with tone might be habitual, or sensory in nature, one could observe the contextual environment for Simeon's pitch shifting behaviours. One could point to the numerous articulations of a consistent tonal pattern that can not accurately be assigned to any specific linguistic tone. A frequently occurring phrase of Simeon's idiosyncratic pitch shifting has been transcribed in as [m̃: ˧:˧:˦˧] (1.146). For the sake of clarity, this pitch shifting pattern can be described as a rising pitch followed by two more in quick succession, lasting approximately three seconds, but often is repeated more than once. This special pitch shifting is found 45 times in the data, and each time appears uniform in its design, but is occasionally cut short in the production of other vocalisations. This pitch shifting pattern is most commonly found in the data affecting an extended bilabial nasal, and for this reason could be considered humming. Elsewhere in the data this pattern can be found affecting mid unrounded vowels such as /ə/ and /ɜ/. These could be considered tonal relationships that are more characteristic of autistic spectrum conditions, specifically around stereotyped idiosyncratic

behaviour (Hyman 2020). To explore this matter further one could look for environments that appear to adhere to similarly internalised structures in the data that can also be described effectively via phonetic means. One could look to the patterns of production around high pitch contours and nasal release palatal plosives environments such as [kⁿḿ kⁿḿ :] (1.143; 1.119) and [gⁿḿ] (1.133). Nasal release plosives such as these are commonly found with high pitch contours. Functionally this could also be equated to Simeon's idiosyncratic pitch shifting, but can be more readily discussed as the notation is markedly simpler.

The notion of Simeon's relationship with pitch shifting being grounded in sensory seeking can be continued when observing the sections of the data that include musical instruments as part of Simeon's interaction with the researcher. Simeon became interested in a bass guitar, and made frequent attempts at matching the tone produced when strumming (8.136-199; 9.3-267). Throughout these sessions, Simeon's vocalisations were influenced by the sound he was able to make through the guitar, and often he attempted to match the tone precisely. A further point of interest regarding the bass guitar sessions, some sections of the data indicate that Simeon was producing the idiosyncratic rising-falling pattern with modified pitch to match the sound coming from the bass guitar (9.257; 9.252; 9.250). One could take these findings as a point of further evidence of Simeon's creative pitch shifting, and as an indicator that he also has a capacity to adapt his vocal play. Furthermore,There is a singular instance within the data where Simeon appears to reproduce the introductory musical phrase from Somebody that I used to Know by the band Gotye (8.79) spontaneously. One could either treat this as indicative or as anomalous, to my mind it is the former, but at this juncture it is not the crux of the argument in either case.

It can be said then, that there are several aspects of pitch shifting data that potentially point towards a relationship between Simeon and specific contour patterns in certain environments. This potential relationship with pitch and tone in general can be defined by fairly consistent phonetic environments and a creative novelty that can not be easily discussed through the IPA. Nonetheless, it is possible to argue a level of tonal awareness - especially evidenced in the idiosyncratic pitch shifting - that demonstrates that Simeon is using pitch contours creatively in his vocalisations.

Central Thai

The data appear to point towards a frequency of specific pitch contours that align with the tone system used communicatively in Central Thai.Central Thai utilises five contrastive tones: high, low, mid, rising, and falling (Tingsabadh 2001).Simeon appears to produce pitch contours which align with each of the Central Thai tones, but mid and high pitch contours are found most commonly. Most common among all of Simeon's pitch behaviours is the mid tone, which occupies 27% of the tonal data. Following that, high pitch contours also comprise approximately 20% of Simeon's tonal utterances, while rising contours occupy 16% and falling 12%. Low pitch contours occupy a mere 5% of Simeon's tonal utterances which is less commonly found than extra high pitches at 6%, and significantly less common than the rising-falling patterns at almost 9%. Pitch contours that can be described as high rising and low rising comprise 2% and 1% of the data respectively. Drawing upon the previously explored tone inventory (Tingsabadh 2001), we can observe that Simeon's pitch contouring appears to align with the communicative tone system of Central Thai 82% of the time. This might indicate that Simeon's exploration of pitch contours may have some root in his relationship with the Isan Thai spoken in his home environment. That being said, to call this a matter of tonal influence implies a level of systemic understanding that we cannot assume Simeon has. Instead, the data may point to vocal behaviours that may be imitative of Thai, largely disconnected from any perceived systems, but potentially reproduced for non-communicative purposes.

We must not make grand claims around whether or not we are to assume a correlation is at all indicative of influence. To adopt the approach of Grove et al (1999) in an unerring critical light, one may observe that the participant's tone usage aligns with the communicative tones found in Thai (Tingsabadh 2001), but remain reticent to apply any notion of influence to this finding. It is important to recognise the novelty of this research, and the potential flaws with such a new methodology that may have begotten these results, and in so doing, we may remain cautious to make claims about tonological influence in this context, especially when considering the matter of English intonation, that the participant will have also been subject to.

Isan

As previously stated, mid pitch contours are most frequently found in the data, and because Isan also utilises a mid tone communicatively (Enfield 2007), one can say that Simeon's pitch contouring aligns with Isan tonology at least 27% of the time. However, no instances of Simeon producing low falling or high falling pitch contours were found in the data, and only small amounts of high and low rising tones were identified. Simeon only appears to produce one pitch contour consistently that can be attributed to Isan (Enfield 2007). Consequently, it would seem that Simeon does not align with the pitch contours found in Isan tonology (Enfield 2007).

English Intonation

Observing the data with the intention of mapping intonation patterns that might be similar to the English tonal system is markedly more difficult on account of its nuance, and its reliance on polysyllabic utterances to appear inherently similar. The data is largely composed of single syllable utterances, and of those that harbor more than one syllable, we see no discernable prosodic patterns. As a result, an exploration of what one would find in English intonation patterns according to Wells (2006), or Halliday, and Greaves (2008), requires some level of deviation from what they have described in their work, in order to begin discussing the likelihood of a tonal influence from English.

One could make an argument that the participant is producing a tonal inventory that includes those that make up English IPs (Wells 2006). However, this does not appear to be occurring in a majority, and also does not stand independently of the tonal inventory of Thai as previously discussed.

Summary

Acknowledging Simeon's sensory needs, and the creative use of tone found throughout the data makes discussion around tonological influence difficult. The fact that Simeon produces pitch

contours that align most with the tonology of Thai (Tingsabadh 2001) could be treated as linguistic influence, but to do so overlooks the consistent, stereotyped pitch contours that appear to abide by their own rules, such as the high tones found with nasal release plosives. To treat these behaviours as evidence of tonological influence overlooks the linguistic nuance of communicative tones. Consequently the context of Simeon's pitch contours renders the investigation of linguistic influence in this manner dubious at best.

Accounting for the apparent alignment with Central Thai tonology (Tingsabadh 2001), one could look at Simeon's capacity to produce consistent pitch contours such as the nasal release plosives with high tone, or the [m̃: ˦:˦:˦˧] patterns. Simeon appears to demonstrate a level of tonal awareness that would allow him to echo tones in his environment. There is a possibility that Simeon was doing so throughout the data, in ways that could be identified as tones on the IPA. If this is the case, then Simeon's pitch contours may only coincidentally align with Central Thai tonology (Tingsabadh 2001).

Furthermore it is worth noting that Simeon did not produce any utterances that could be described as IPs in the way that Wells (2006) describes. As a result, Simeon was only ever likely to produce pitch contours that would align with languages that have lexical tones, rather than intonation patterns that span several words. In this way Simeon was not able to demonstrate an English use of intonation (Wells 2006). This places Central Thai and Isan at a greater likelihood of presenting influence in Simeon's utterances. This may be a reason Simeon's utterances appear to align with Central Thai so dramatically.

Conclusion

Returning to the hypothesis:

- Simeon can produce utterances that are phonetically and tonally similar to those found in his linguistic environment.

We have seen that Simeon produces consonants and vowels that appear in the inventories of his home languages. The formant analysis of Simeon's vowel articulations were found to align with his parents when producing similar phones. Tonal similarity was difficult to comment on, due to the lack of reference for non-verbal pitch-contouring. However, the syllable structure identified in the data, appears to align somewhat with Crystal's (2003) phonotactic structure of english. With these findings we have answered the three research questions that were posed in the design of the study.

Implications

While the findings of the research appear to support the hypothesis, it is still debatable as to whether or not one can consider these results evidence of phonological influence. This research intended to explore the nature of the vocalisations of an individual who does not communicate verbally, by utilising tools such as the IPA and its extensions (ICPLA 2015) to transcribe his vocalisations. In doing so, patterns have been observed, and generalisations such as phonotactic rules have been produced from the data, which would imply the presence of a phonetic system. The term for an organised phonetic system of language is called phonology. Simeon's vocalisations fall short of that definition for a number of reasons. The first reason is that we cannot claim that his utterances have any clear target word or goal in mind at any point within the data, which precludes them from discussions around realizational variations, allophones, minimal pairings, and other more involved phonological phenomena. As a result of this we can see the limits of dividing vocal data into speechlike and non-speechlike categories, as previous studies have (Xu et al 2014; Paul et al 2011; Garrido et al 2017; Trembath et al 2019; Schoen et al 2011). Instead we see Simeon's vocal behaviour appearing to be speechlike up to a point - in certain features of phonotactics, phone production and organisation - but not adhering to the full organisational structure of sounds that typical speech has.

Similarly, but on a larger scale, the second reason is that there is no foundation of language to Simeon's vocalisations. Even if one could begin to approach his phonetic system as a phonology, there is no reason at all to believe that it could be compared to anyone else's the

way accents and dialects can be compared in language. The data provides no reason to believe that a similarly raised individual with PMLD would produce utterances of a similar phonetic system. More research into non-verbal vocalisations must be conducted before statements such as this can be made. Here the findings of this case study query the application of the speechlike and non-speechlike dichotomy (Xu et al 2014; Paul et al 2011; Garrido et al 2017; Trembath et al 2019; Schoen et al 2011), for vocal behaviours that do not appear to have a foundation of language. While Simeon's vocal data has demonstrated a set of phonotactic rules, and a clear phone inventory that has allowed for the construction of a linguistic profile, to say that Simeon's vocal behaviours are speechlike seems inaccurate while there is no speech to which it appears to emulate. One could imagine that if Simeon were expected to go on to acquire language this might be useful terminology but without this foundational expectation of language, the term does not appear appropriate.

One could describe Simeon's utterances to be something more organised than simply arbitrary phonetic experiments, but not organised enough, or linguistic enough to be considered phonology. Instead the data occupies a middle space that appears to behave like a phonological system with no grounds in language, and exists as a loosely bound system of phonetics that only remains cohesive by way of the consistent measurable preferences of the speaker. The phonetics of Simeon's vocalisations does not display any great departure from what has already been found in spoken language, but beyond that there is an apparent system of syllable structure, and an inventory of phones that remain fairly well maintained, and consistently produced.

Furthermore, Simeon's consonant and vowel inventories appear to align with the English and the Thai dialects he has been exposed to. The fact that the consonant data appears to align in certain ways with Simeon's home languages implies that Simeon's phonetic system bears some influence from the phonologies of Isan, Central Thai, and English. Simeon's vocalisations do appear to present features of phonological influence from his home languages. Furthermore Simeon appears to articulate certain vowels in the data in very similar ways to his parents. This indicates a level of similarity in Simeon's phonetic inventory with that of his home languages. Thus, Simeon's phonetic inventory appears to abide by some level of system that can be influenced by the language variants heard in his environment. In many ways this can be likened to the acquisition of accent features in people with autism as presented by Baron-Cohen and

Staunton (1994), which highlighted the home as the primary phonological influence of the autistic language learner even through periods where peers typically dominate.

It is understood that Simeon's vocalisations are not communicative and instead his communication takes the form of signing. Observing this fact grounds the data in a light that is foundationally descriptive regarding his use of phones. When vocalisations are entirely without communicative goal, as we see in the data, there are points where phonology as a discipline fails to apply, and so as to avoid presenting Simeon's vocal behaviours as a failure to meet the nuance of phonology, an alternative approach is employed. The design of the alternative approach solely engages in phonological analysis regarding phonotactics, and the measurement of potential influence from external phonologies upon Simeon's vocal behaviours. In this way, Simeon's phonetic inventory can be measured and discussed in a way that does not harbor any preference for lingualism. This middle space between pure phonetics, and the structures of phonology will become more accurately defined as progress in this field continues, and research such as this will be repeated. For now, this approach will remain focused on the patterns of behaviour found in Simeon's use of phones, both in relation to one another in phonotactics, and in their influence from external phonologies.

Such an approach allows for accurate discussion of the defining features of Simeon's vocal behaviour while simultaneously excusing the data from studies that do not fully apply. As such, we may discuss Simeon's preference for the utterance [dʊgədugədug], as an example of syllable structure in his utterances. Such a discussion may also include examples of structurally, and phonetically similar utterances such as [dʊgədʊgədʊgədʊgədɤ] or even [dˤɪkədˤək]. The similarity of these utterances is easily discussed phonotactically. The primary feature of this approach is that there is no expectation beyond that, and hence the discussion can remain purely descriptive, and not concerning itself with external linguistic structures. As previously mentioned, phonology can be described as the phonetic system of a language, and as such does not truly apply to environments where there is no language. This is not to say that none of the features of phonological study beyond what have previously been discussed have bearing in this context. Phonotactics, vowel formant analysis, and phonetic inventory comparison have undoubtedly shed light on the features of Simeon's vocalisations. However these approaches are only applied to the point of linguistic complexity that the data can be subjected to without projection or over-advocacy. Instead this approach is solely interested in the observation of patterns in the data, with the express intention to describe the results of Simeon's vocalisations.

For clarity at this point, it should be made clear that the fact that phonology does not entirely apply to this circumstance is no slight against the practice of phonology. Instead this is a recognition of the extreme nuance wherein this study can be found.

There could be a number of criticisms levelled at the approach detailed in this section, and the observation of a space between raw phonetics, and complex phonology. The primary criticism rests in its relevance. I have already articulated that phonology is not appropriate for this matter, but the immediate solution to this problem is that for a study such as this, one need not utilise all functions of phonology. This is true, and has been acted upon in the formulation of this study. However this criticism overlooks the apparent phonetic relationship Simeon has with his linguistic environment. As discussed previously, Simeon's syllable structure can be described as $(O^{(N)})S^{(T)}(O^{(N)})$, but frequently in the data we can see utterances that consist of two or three phones repeated, and other utterances that comprise a single phone briefly produced. These utterances can be found throughout the data for reasons purely pertaining to Simeon preference for them. Furthermore their presence in the data makes them a fairly commonly found feature observed in Simeon's vocalisations.

This study has further implications for the construction of linguistic profiles for nonverbal and minimally verbal communicators. This study has found that observing nonverbal vocal behaviour may reveal some linguistic features which align with the individual's environment. These findings imply that an individual like Simeon can demonstrate features of South East British English or Isan Thai which can contribute towards the construction of an identity for him as a Thai man who has lived in the south of England for a number of years. In this way the findings of this study allow for a meaningful and valuable understanding of Simeon's history, and identity purely by observing his vocal behaviours. This can be used to better discuss and engage with nonverbal and minimally verbal communicators as people with rich linguistic identities and seemingly unique means of displaying them vocally.

The study may also be used to address situations similar to those found about Simeon - wherein his apparently Thai-sounding vocalisations were often mistaken as words despite evidence that he was not communicating at word level. Situations such as these are not uncommon for nonverbal communicators from multilingual backgrounds, but may now be addressed with an understanding that at least in Simeon's case, he is able to produce syllables

constructed of both Thai and English phonemes. In this way, studies such as this one could provide greater insight into the linguistic identity of nonverbal people from bilingual and multilingual environments, and decrease the likelihood of support staff misunderstanding the stage of communicative development.

As such, communication and interaction can be aided by the construction of linguistic profiles for non-verbal people as it can begin to demystify their linguistic identity. Furthermore a clear linguistic profile for someone like Simeon would have avoided mistaken paths towards seeking to interpret his vocal behaviours as one would with Thai speech. Clarifying facts such as Simeon's Thai phonological influence but at the same time maintaining his non-verbal identity contributes to a greater understanding of him as a vocaliser and as a communicator. Simeon's linguistic profile sheds light on the nature of his vocalisations as it displays the range of phones he has presented over the course of a number of recording sessions. Consequently when observing Simeon's profile one could find a range of vocalisations that one could expect to hear when spending time with him. This coupled with the consistent finding that Simeon has not produced communicative vocal behaviour throughout the course of the study enforces his identity as a non-verbal communicator. All together, the construction of Simeon's linguistic profile has clarified how Simeon vocalises and how his vocalisations can be treated in relation to his communication methods. In this way the practice may be used to clarify these matters for other non-verbal people from multilingual backgrounds.

Further study

The question of necessity continues in a slightly different direction, regarding the importance of such a study as this in general. This manner of questioning is often difficult to address without emotion, in general discourse. One could say that the linguistic study of nonverbal individuals is unlikely to yield any substance. I do not agree. I believe that the utterances of nonverbal individuals are inherently interesting, for their similarities and differences to the structures and patterns of spoken language. I believe the findings of the research have at least demonstrated that Simeon, a nonverbal gentleman, has a complex and nuanced relationship with his linguistic

environment and one that warrants further investigation. It is my intention to replicate this research in a number of new cases in the future.

This study can be improved upon by the introduction of a control participant, who does not have direct access to tonological languages, so as to measure a conventional relationship between the non-verbal speaker, and tone.

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Appendix A:

Letter of Ethical Approval

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Richard Carter
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12 April 2019

Dear Rich,

I am pleased to inform you that your project *"Accents in Preverbal Vocalisations: Investigating Linguistic Identity in individuals with Profound and Multiple Learning Disabilities"* has been approved by the Cross-School Research Ethics Committee for the School of Education, School of Humanities, Religion and Philosophy, and School of Languages and Linguistics.

The approval code is **RECll00016**.

You may now proceed with the project.

Yours sincerely,

Prof Christopher J Hall, Chair

Est. 1841