Individual difference factors and linguistic complexity in sequential bilingual acquisition

by

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I confirm that the word count of this thesis is less than 100,000 words excluding the title page, contents acknowledgements, summary or abstract, abbreviations, footnotes, diagrams, maps, illustrations, tables, appendices, and references or bibliography.

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Abstract

Differences in bilingual language acquisition are often associated with variation in individual difference factors such as chronological age, quantity and quality of exposure, and cognitive capacities. Previous findings on the impact of these factors are mixed. However, factors are often confounded by other variables, tasks used, or divergent first language backgrounds. The present study aims to consider the impact of individual difference factors on sequential bilingual acquisition by taking a novel and multi-pronged approach to the analysis of issues that clearly demand a complex research paradigm. This includes incorporating the following measures: inclusion of a number of individual difference factors with separate measures of fine-grained input, analyses to reduce dimensionality between correlated variables; measurement of interdependencies between predicting factors; controlling the participants' L1 background; measuring the impact of factors on both complex and non-complex language features; and the use of a novel experimental task comprising a simple and interactive format designed to reduce processing costs and age bias.

Participants were 40 Arabic-speaking children acquiring English as a second language (L2) (5;7 to 12;2 years old) alongside 40 age-matched monolingual controls. The dependent variable was accuracy of language measures: regular (third person singular) and irregular (past tense) morphology; canonical (actives) and non-canonical (passives) word order; subordinate clauses (relative clauses) and intervening elements in long distance dependencies (object relatives); and lexical proficiency. Independent variables were age of L2 onset, chronological age, short-term memory, motivation for learning the L2, richness of the L2 environment, L2 use at home, L2 use at school, and socio-economic status.

Generalised linear mixed effects modelling revealed the following for the bilingual participants: length of L2 exposure predicted vocabulary and morphology; chronological age predicted interpretation of sentences; short-term memory predicted production of morphosyntax; L2 richness predicted interpretation of all target sentences and interacted with chronological age for interpretation of complex syntax; and greater L2 use at home, a younger age of onset, and higher socio-economic status did not predict any measure. For the monolinguals, chronological age

predicted vocabulary and morphology and production of morphosyntax while short-term memory predicted interpretation of syntax.

Results suggest the following for sequential bilingual children: overall exposure to language is important in the acquisition of vocabulary and morphology; greater maturation of cognitive and linguistic skills associated with older ages in childhood and greater participation in L2 play and social activities facilitate interpretation of sentence structures; increased participation in L2 play and social activities further enhances interpretation of complex sentences when children are older; short-term memory appears to play a role in processing expressive morphosyntax which may be linked to greater processing demands bilinguals experience with language phenomena when it interfaces with discourse; and starting to acquire a language at a younger age does not result in greater language proficiency. For the monolingual children, greater maturation of cognitive and linguistic skills associated with older ages in childhood facilitate most language features while short-term memory appears to play a role in processing the syntactic features of language.

This study builds on valuable previous research investigating individual differences in sequential bilingualism. By teasing apart the impact of factors, the study provides further insights on the effect of these factors across linguistic domains as well as novel findings on how predictors interact to impact language proficiency.

1. Introduction

This project investigates the impact of individual difference factors on the proficiency of a range of language measures for sequential bilingual children. This thesis is a cross-sectional research study of school-aged children in Northern Ireland. The sequential bilingual participants were from immigrant and refugee backgrounds and spoke Arabic as a first language (L1) at home and were acquiring English as an additional language. The study offers a unique perspective on the impact of individual difference factors by using a novel experimental methodology, incorporating statistical analysis to reduce dimensionality between correlated variables, investigating interdependencies between factors, measuring a number of language features which are complex and non-complex, and comparing results with monolingual controls.

The motivation for investigating sequential bilingual language acquisition started from my own experiences teaching and supporting the language skills of children acquiring English as an additional language both abroad and in Northern Ireland. Through these experiences I was fascinated not only to see the children's language skills develop but to observe the progression of different types of language as well as the influence of background factors such as age and input. These experiences motivated my master's thesis which investigated age, input, and cross-linguistic influence in the acquisition of English verbal morphology in sequential bilingualism. The current study brings this a step further to investigate a variety of linguistic domains including both complex and non-complex language features and the impact of a larger number of individual difference factors.

Investigating the language development of immigrant and refugee children is highly topical both in the Northern Irish context and further afield (Walsh, 2020). The growth of immigrant populations worldwide means the numbers of sequential bilingual children have increased significantly (Murphy & Evangelou, 2016). Such children are identified by the Department for Education in Northern Ireland (2009, p.iii) as 'newcomer' pupils, defined as

> "a pupil who has enrolled in a school but who does not have satisfactory language skills to participate fully in the school curriculum and does not have

a language in common with the teacher. It does not refer to indigenous pupils who choose to attend an Irish medium school".

Numbers of newcomer children in Northern Ireland schools have been growing for over a decade. In 2018/19 there were 16,238 newcomer pupils in schools in Northern Ireland - making up 4.7% of all school enrolments with the largest area of growth in primary schools (Department of Education Northern Ireland, 2019) [1]. Acquisition of English is vital so that newcomer children are able to integrate into all aspects of their school environment such as accessing the school curriculum, academic achievement, and interacting socially with peers and friends as well as the wider majority ethnolinguistic community (Department of Education Northern Ireland, 2009; Hutchinson 2018; Mahon & Crutchley, 2006; Murphy, 2014).

While it has been shown that simultaneous bilingual children generally proceed relatively normally through the same developmental sequences as monolinguals, sequential bilingual children may have more difficulties in the initial stages of L2 acquisition (Meisel, 2011). Acquisition of an additional language typically presents with substantial individual disparity among learners, an inconsistency commonly attributed to a number of individual difference factors (Granena, 2014). These factors are often described as internal or external to the individual (Paradis, 2011; Unsworth et al., 2011). Internal level factors are related to variables of biological, cognitive and psychological influence such as age, memory, and motivation (Dörnyei, 1998; Paradis, 2007; Chondrogianni & Marinis, 2011; Paradis, 2011). External factors are those which refer to the experiential environmental context of language exposure which can include quantity and quality of language exposure from both proximal (direct) and distal (indirect) input sources

[1] The majority of newcomer pupils in Northern Ireland are Polish speakers, followed by Lithuanian, Portuguese, Romanian, and then Arabic speakers (Department of Education Northern Ireland, 2019). In the 2017/18 school year there were nearly 650 Arabic speaking children enrolled in primary and secondary schools across Northern Ireland (Department of Education Northern Ireland, 2018). A high number of Arabic speaking pupils are refugees from the Syrian conflict who have been resettled in Northern Ireland (there are proportionately more Syrian refugees resettled in Northern Ireland compared to other regions of the UK) (Walsh, 2020). Syrian nationals resettled from the conflict now account for 0.08% of Northern Ireland's population (Walsh, 2020). Therefore, while sequential bilingual children represent a substantial proportion of the school population, Arabic speaking children are forming an ever-increasing part of this group.

across various settings such as at home, school, and participation in social activities (Paradis 2007; Paradis, 2011).

A greater understanding of these aspects allows insights which are relevant to different kinds of beneficiaries including researchers, educators, clinicians and parents. In the educational setting a better understanding of sequential bilingualism has the potential to help teachers and teaching assistants prepare, adapt and deliver more appropriate classroom activities and materials which ultimately better facilitate the educational progress and outcomes of newcomer pupils (Paradis, 2011). This is critically important as many newcomer pupils show low attainment in educational qualifications compared to non-newcomer students (Department of Education Northern Ireland, 2009). These insights could also be useful in advising parents who wish to encourage the child's L2 proficiency, and in progressing research in the area which in turn could help guide policies and frameworks which ultimately contribute to more informed procedures and best practice.

Research on second language acquisition has typically found advantages for those who begin the process at earlier stages which has contributed to the predominant view that 'younger is better' for acquisition of an additional language (e.g., Abrahamsson & Hyltenstam, 2009; Coppieters, 1987; Curtiss, 1977; DeKeyser, 2000; Gleitman and Newport, 1995; Johnson & Newport, 1989, 1991; Oyama, 1976; Patkowski, 1980, 1994; Schachter, 1990; Schwartz, 2004). However, many of these studies are retrospective in nature with the participants being tested in adulthood and have not always taken detailed account of the different types and amount of language exposure which is shown to impact language acquisition. While some individuals may experience rich language exposure (e.g., through integrating more with the majority language community, completing higher education in the majority language, and having parents with high proficiency levels in the L2), others' exposure may be much more limited.

Research investigating the influence of factors on language proficiency of those still within childhood and incorporating a larger number of factors has brought valuable insights on the language acquisition of the sequential bilingual population and the role of age and input effects (e.g., Armon-Lotem et al., 2011; Bedore et al., 2016; Blom & Bosma, 2016; Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; De Cat, 2020; Jia and Fuse; 2007; Paradis, 2011; Nishikawa, 2014; Paradis &

Blom, 2016; Paradis et al., 2017; Roesch & Chondrogianni, 2016; Rothman et al., 2016; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978; Unsworth, 2016a) Findings from these studies show that while older children have an advantage in the development of lexical knowledge (Blom & Bosma, 2016; Golberg et al., 2008; Paradis, 2011; Snedeker, 2007; Snow & Hoefnagel-Hohle, 1978; Unsworth, 2016a), age effects appear less robust in the morphosyntactic domain (e.g., Chondrogianni & Marinis, 2011; Nishikawa, 2014; Bedore et al., 2016; Blom & Bosma, 2016; Paradis & Blom, 2016; Roesch & Chondrogianni, 2016).

In terms of age of L2 onset, findings are mixed across studies with positive (Rothman et al., 2016), negative (e.g., Bedore et al., 2016; Nishikawa, 2014; Roesch & Chondrogianni, 2016), or limited or no effects on morphosyntactic features (e.g., Blom & Bosma, 2016; Chondrogianni & Marinis, 2011; Snedeker et al., 2007; Paradis & Blom, 2016; Paradis et al., 2017; Unsworth et al., 2014; Unsworth, 2016a). Chronological age mostly predicts morphological features (Snow & Hoefnagel-Hohle, 1978; Paradis, 2011) however, while some studies have found an advantage for this factor in relation to sentence structures (e.g., Bohman et al., 2010; Paradis et al., 2017) others have not found an effect (Chondrogianni & Marinis, 2011).

Working memory appears to be an important factor in children's bilingual or second language development. Working memory involves both the capacity to temporarily hold information from the environment in mind as in the short-term memory component of working memory, and the retention, processing, or manipulation of that information (Baddeley & Logie 1999; Baddeley, 2003; Gathercole & Alloway, 2007). While the short-term memory component of working memory has been shown to predict vocabulary (e.g., De Cat, 2020; Engel de Abreu et al., 2011; Paradis, 2011; Thorn & Gathercole, 1999; Verhagen & Leseman, 2016) and morphology (Paradis, 2011; Paradis et al., 2016), results for syntactic structures are more mixed. Some studies have shown positive effects for the impact of both short-term and working memory (e.g., Engel de Abreu et al., 2011; Verhagen & Leseman, 2016), while others have found that only the short-term memory component predicted accuracy of complex structures (e.g., De Cat, 2020).

Language exposure can encompass different quantities and qualities depending on the individual's involvement with the second language at home, school, and outside of school which can include play with second language speaking peers, parental second language proficiency, and socio-economic background (e.g., Bohman et al., 2010; Chondrogianni & Marinis, 2011; Hammer et al., 2012; Paradis, 2011; Sorenson Duncan, 2017; Sorenson Duncan & Paradis, 2018). Including these more fine-grained factors helps to give a more holistic picture of the individual's second language experience. However, studies which have included fine-grained measures of input (e.g., second language use at home and/or cumulative measures of second language exposure) reveal mixed findings for morphosyntax (e.g., Chondrogianni & Marinis, 2011; De Cat, 2020; Paradis, 2011; Paradis et al., 2017; Roesch & Chondrogianni, 2016; Sorenson Duncan & Paradis, 2018). Cumulative measures of second language exposure and use at home have shown weak or no effects (e.g., Armon-Lotem et al., 2011; Unsworth, 2016a) while others have found this type of exposure to be the most important factor for proficiency of target sentence structures (e.g., De Cat, 2020; Roesch & Chondrogianni, 2016). Studies which have included separate measures of input have found that language use at home has negligible effects for morphosyntax (Chondrogianni & Marinis, 2011; Paradis & Kirova, 2014; Paradis et al., 2017) while richness of the language environment has shown positive effects in this domain (e.g., Paradis, 2011; Paradis et al., 2017).

Tasks employed to measure target language have varied from study to study and in some cases these measures may have involved putting greater demand on language processing which also may have inadvertently advantaged one set of participants over another. A common method for measuring morphosyntactic proficiency involves a multiple-choice picture matching task where participants are asked to choose the picture which best represents the sentence heard (e.g., the Diagnostic Evaluation of Language Variation, DELV, Seymour et al., 2005). These tasks involve participants holding the target sentence in mind while processing the actions in different pictures. However, this may put greater demand on processing and therefore a participant's performance may in fact reflect non-linguistic (in this case, cognitive) as opposed to linguistic skills (Marinis, 2010; Frizelle et al., 2019).

In addition, cohorts have often involved divergent L1 backgrounds which may have biased results. Shared structural typological features between the L1 and L2 have been shown to create convergent target language constructs which facilitate

L2 progress, while different typological features can result in divergent patterns (Alexopoulou, 2020; Blom et al., 2012; Haznedar, 1997; Gilkerson, 2007; McDonald, 2000; Murakami & Alexopoulou, 2016; Zdordenko, 2010). Indeed, some theories of L2 acquisition view the L1 as a main source of influence in acquiring the L2 (e.g., The Fundamental Difference Hypothesis, Bley-Vroman, 1990; Full Transfer/Full Access Model, Schwartz & Sprouse, 1996), and interference between languages have shown that the dominant language frequently influences the weaker language (e.g., Bernardini & Schlyter, 2004; Hohenstein et al., 2006; Matthews & Yip, 2000).

Collinearity between influencing factors may also have had an impact on previous studies' results. Collinearity can transpire when an unintended variable, separate from but related to the target factor, is measured along with the intended variable. This can result in a bias of the relationship between dependent and independent variables thereby obscuring the actual impact of the target predictor (Grimes & Schultz, 2002; Jager et al., 2008; Skelly et al., 2012). Measuring a greater number of influencing factors can help to account for their effects. However, it may be the case that these variables are correlated with each other. An example of this is that overall length of exposure to the target language is linearly related to age of onset which results in a high correlation which may allow only a weak account of age of onset and length of exposure effects (Stevens, 2006). Therefore, it is also important to consider how to disentangle the collinearity between target factors.

The current study builds on this previous research but takes a novel and multi-pronged approach to the analysis of issues that clearly demand a complex research paradigm. This thesis addresses these gaps by incorporating the following measures: inclusion of a number of individual difference factors with separate measures of fine-grained input; analyses to reduce dimensionality between correlated variables; measurement of interdependencies between predicting factors; controlling the participants' L1 background (all had Arabic as an L1); the use of a novel experimental task comprising a simple and interactive format to reduce processing costs and age bias; and the use of standardised tests comparable to previous studies. These measures allowed a more nuanced and holistic evaluation of the impact of individual difference factors on the language proficiency of sequential bilingual children. To that end, the current study seeks to contribute to this highly topical field by providing further insights into which individual difference factors predict language proficiency for this population. As such, this thesis addresses the following main research question: Which internal and external individual difference factors better predict accuracy of complex and non-complex language measures in childhood sequential bilingual acquisition? A more detailed consideration of the research questions which guide this study is provided in Section 3.7.

In what follows, the category of bilingualism and its definitions are explored before outlining a review of sequential bilingual language acquisition in childhood and providing a detailed rationale for researching this particular bilingual group. In chapter 2, the various factors which influence sequential bilingual language acquisition and previous research carried out thus far in these domains are reviewed. In chapter 3, what constitutes complex in terms of language from both a structural and cognitive perspective are explored. From this, we show that linguistic complexity entails irregularity, non-canonical word order, and intervening elements. In chapter 4, the methodology used in the current study is presented which includes the tasks used to measure language proficiency. Chapter 5 explains the methodology used in relation to the generalised linear regression modelling for the statistical analyses of data, after which the results of the analyses are presented. In Chapter 6, a critical discussion of the results is offered followed by limitations and recommendations for future research. The final chapter provides concluding remarks in relation to the main findings of the research study.

1.1 Bilingualism

Bilingualism is a global phenomenon with over half the world's population estimated to fall within this linguistic category and two-thirds of children growing up in a bilingual environment (Bhatia & Ritchie, 2013; Crystal, 2003; Grosjean, 2010). The presence of bilingualism is evident in nearly all countries and even those that are widely considered monolingual typically have both indigenous and immigrant populations using languages or dialects other than the dominant language of the country (Romaine, 1995). Occurrences of bilingualism, currently and historically, are commonly due to language contact through migration as people move to other regions for employment purposes or as a result of colonisation or conflict (Edwards, 2013; Grosjean, 2010). On an individual level, instances of bilingualism arise as a result of a communicative necessity to interact with the wider community while from a broader social perspective bilingualism can emerge due to cultural (e.g., preservation of heritage, identity and traditions) or political (e.g., language to facilitate business or administrative purposes, or in promoting one linguistic or ethnic identity over another) reasons (Edwards, 2013).

Finding a concrete definition of bilingualism which covers all its instances is challenging. While being bilingual clearly involves the knowledge and use of two languages, descriptions of this term appear to apply different measures. A commonly held view of bilingualism is having fluency and equal proficiency in both languages (Bloomfield, 1933) or having the capacity to communicate in complete and meaningful utterances (Weinreich, 1953). However, more recent definitions shift the focus from ability to use of more than one language in the individual's everyday environments (Grosjean, 2010). This latter description, although encompassing a broader and varied view of bilingualism, allows the inclusion of more commonly existing bilingual situations. Bilinguals can present with a variety of capabilities along a spectrum of proficiency thus moving away from the idealised version of bilingual speakers being necessarily balanced (Edwards, 2013; Grosjean, 2010). This view of bilingualism is crucial to the current study which includes bilingual individuals who may present with different linguistic abilities in the languages they know. This may affect their ability to use each language comprehensively but who nevertheless utilise both in their everyday lives as a necessity of the environments they find themselves in (e.g., at home or at school).

The consequences of having the knowledge and use of two languages in the brain, as opposed to one, produce linguistic and cognitive patterns and behaviours which diverge from monolingual acquisition (Slabakova, 2016). Before the 1960s, distinctive linguistic patterns evident in bilingualism were commonly associated with negative conditions including cognitive deficits, low intelligence, confusion and even pathological states (e.g., Goodenough, 1926; Saer, 1923; Thompson, 1952). However, research since then has generally found bilingualism to be advantageous, and to have no detrimental effect on the language acquisition of children with neurodevelopmental disorders (e.g., Ulijarevic et al., 2016). One of the most well-known or studied advantages of bilingualism includes an association with greater cognitive processing within the domain-general executive function

(Bialystok 2018; Kroll et al, 2015a). Also, from a sociocultural perspective, being bilingual is often associated with being bicultural and immersion in both domains has shown positive psychosocial outcomes as it creates opportunities for greater interaction and ways of seeing the world which in turn can lead to more enriched life experiences (Chen & Padilla, 2019; Forsman, 2010; Sung, 2016).

Despite the many advantages associated with bilingualism in terms of linguistic ability, the course of bilingual acquisition can often show protracted development in comparison to monolingual acquisition (Cobo-Lewis et al, 2002; Gathercole 2002a; 2002b; 2007a), a factor often attributed to the variability in linguistic experience the bilingual individual encounters. Differences across experiences and outcomes appear to be one of the definitive features of bilingualism, a feature associated with variation in when linguistic experience commences (i.e., the age of onset of acquisition) and the quantity and quality of linguistic input the individual receives (Gathercole, 2014; Unsworth, 2016b), characteristics not found typically with monolingual acquisition.

While age of onset is often used to categorise types of bilingualism (see Section 1.2), some researchers emphasise the importance of framing the definition of bilingualism in terms of sociocultural factors which aim to capture the influence of the environment (e.g., types and amount of input) on the individual's development of language thereby depicting a more holistic perspective of the linguistic situation (Skutnabb-Kangas, 1991). Typically, bilinguals obtain input of their two languages from various sources which may result in more or less equal exposure across the two languages or in many cases, imbalanced exposure, which can greatly prejudice the linguistic outcomes of the two languages often to the detriment of the language which has a minority status in the wider community (Gathercole, 2014; Unsworth, 2016b). Input factors are an important consideration for the present study as these will be measured as predictor variables in the analysis. These factors will be explored further in Section 2.3.

1.2 Types of bilingualism in childhood

A broad definition of bilingual children is given by Kohnert (2010, p.456), who describes this population as,

> "those individuals who receive regular input in two or more languages during the most dynamic period of communication development- somewhere between birth and adolescence. This intentionally broad definition includes children who learn two languages from birth as well as those who learn a single language from birth and a second language beginning in childhood."

Bilingualism within childhood is often divided into narrower categories many of which are based around the individuals' age of first exposure to their acquired languages (or age of onset of acquisition). It should be noted that currently there remains no overarching consensus on how categories of bilingualism in childhood are applied to particular age groups (Nishikawa, 2014). As noted by De Houwer (1990) and Deuchar and Quay (2000), in some cases, terms and delineations of age are used differently among researchers and authors. Common categories of bilingualism within childhood include bilingual first language acquisition; simultaneous bilingual acquisition; early second language acquisition; early sequential bilingual acquisition; sequential (or successive) bilingual acquisition; and child second language acquisition.

De Houwer (1995) proposes using Meisel's (1990) term bilingual first language acquisition to describe situations where the individual begins regular exposure to two languages within the first month of life. Another common description for the acquisition of two languages from birth is simultaneous bilingual acquisition (Padilla & Lindholm, 1984) reflecting the fact that both languages are being acquired simultaneously. However, this term is often also applied to those who begin acquisition of an additional language sometime after acquisition of the first language has begun. For example, Paradis et al. (2011) use this term to include those who begin exposure to an additional language within the first year of life while its description has also been extended to include those beginning exposure from birth up to three years old (e.g., McLaughlin, 1978). It is possible that differences exist between children who are exposed to two languages regularly from birth and those who were essentially monolingual until being exposed to a second language sometime after birth. Reflecting this, De Houwer (1990, 1995, 2009) proposes the term early second language acquisition to describe monolingual children who become bilingual sometime before the age of six. More recently the term early sequential bilingual acquisition has been used to refer to exposure of an additional language between the ages of one and three years old (e.g., Meisel, 2008, 2009, 2016; Unsworth, 2013).

Beginning acquisition of an additional language on or after 3 or 4 years old is often described as child second language acquisition, a term typically used interchangeably with sequential bilingualism or successive bilingualism (e.g., Grosjean, 2010; Meisel, 2009; Paradis, 2011; Paradis et al., 2011; Schwartz, 2004a; Unsworth, 2005). The principal motive for setting the initial exposure phase of this category between 3 and 4 years old is that most of the native language grammar including word order and nominal and verbal inflection is in place by this stage (Guasti, 2002; Lakshmanan, 2009). Therefore, the other language is acquired distinctly as a second language rather than in concurrent form whilst the first language is in its primary developmental phase (Schwartz, 2004a). The upper boundary for child second language acquisition is typically proposed to be age 7 (e.g. Grosjean, 2013; Meisel, 2009; Schwartz, 2004a; Unsworth, 2005) reflecting empirical evidence from adult second language acquisition which has shown that those who begin their exposure prior to age 7 perform similarly to native speakers while those who begin after this age are more similar to those acquiring a second language in adulthood (e.g., Abrahamsson & Hyltenstam, 2009; DeKeyser, 2000; Gleitman & Newport, 1995; Johnson and Newport, 1989, 1991; Schwartz, 2004;). This earlier advantage for language acquisition reflects the notion of a critical period whereby linguistic proficiency is only possible if acquisition begins before a particular age (Lenneberg, 1967; Penfield & Roberts, 1959) (see Section 2.2.1).

While the common delineation for child second language acquisition is an age of onset between 3 or 4 and 7 years old, some researchers propose slightly later boundaries. For Gass and Selinker (2008) this is between age 5 and 9 years old with the advanced lower cut-off point allowing for late acquired linguistic features to be appropriately established. Lakshmanan (2009) suggests a wider age range in describing this population—from age 3 until puberty (again, indicating a critical period for language acquisition: Lenneberg, 1967; Penfield and Roberts, 1959). This extended range (3 years old to puberty) has also been divided into an early and late phase with the early child second language learner range between ages 3 to 7 and the late range from age 7 to puberty (Haznedar & Gavruseva, 2013).

In summary, definitions of bilingualism within childhood are often based on different ages of onset of acquisition. While these are grounded in empirical research, studies are limited and, in some cases, reflect findings from different linguistic domains (e.g., phonological, lexical, morphosyntax; or different types of linguistic elements within those domains). However, it may be the case that cut-off points in one domain do not reflect age of onset differences in another language area (Muñoz and Singleton, 2011). More recent findings suggest much younger age of onset effects than has been previously stated (e.g., Meisel, 2018—age 3;6 for gender marking). Therefore, a priori, a concrete delineation defining the lower and upper boundaries of each bilingual category remains somewhat speculative (McLaughlin, 1978; Meisel, 2008, 2011). As Unsworth (2005) asserts, definitive cut-off points can only be ascertained through further empirical investigations. The definitions of child bilingualism representing different age of onset categories above are important for the current study as age of onset will be measured and analysed as a predictor variable in the proficiency of the target linguistic areas. Further information on effects of age (including both age of onset and chronological age) will be explored in the literature review (Section 2.2).

In relation to the current study, the term *sequential bilingual* will be used to describe the bilingual participants. This is due to a number of the participants falling outside of the boundaries for child second language acquisition in that they began meaningful (consistent and significant) exposure to English earlier than 3 years old. However, they all began acquisition of English sequentially (sometime after acquisition of the first language) and although they may have reduced proficiency in the target language, they are nevertheless bilingual in that they hear and use both languages on a daily basis. Therefore, we feel that referring to the participants as sequential bilingual is the more appropriate description in this context.

The following section will explore the domain of sequential bilingualism further, including a general description of this population and the relevance of researching this linguistic group.

1.3 Sequential bilingual acquisition

Sequential bilingual acquisition is often affiliated with child immigrant populations—those who are child immigrants themselves or those who are the children of immigrant parents (Montrul, 2008). In both cases, the first language is a minority language of the community in which they live and is generally used at home and with other members of their minority language group. This means that as well as being sequential bilinguals, these children can also be characterised as heritage speakers of their first language (Valdés, 2000)[2]. The second or additional language is typically the societal or majority language of the wider ethnolinguistic community and the language of instruction at school and that which they speak with their school peers (Paradis et al., 2011). Due to acquiring the second or additional language in an immersion capacity through school, this type of language acquisition has been characterised as naturalistic second language learning (Muñoz, 2008). Paradis (2007) describes these children as first language minority-second language learners. Other types of sequential bilingualism (or child second language acquisition) include foreign language learning situations where the second language is not the majority language of the wider community and is learned on a much more limited basis during set times within a school schedule (Muñoz, 2008; Rothman et al., 2016). In this situation the children would be first language majority-second language learners (Paradis, 2007). However, in many cases like this, especially within the public (non-private/non-immersion) school sector, exposure to the second language can be very restricted, limited to one or two one-hour classes per week (Muñoz, 2008).

Many immigrant children are monolingual in their native language until beginning meaningful contact with the majority second language on commencing nursery or primary school in the new country (Montrul, 2008). There appear to be differences exhibited between sequential bilinguals and other types of child bilingualism which can be seen in the process that linguistic development takes. In simultaneous bilingual acquisition (or bilingual first language acquisition), despite some contrasts, linguistic development typically continues on a similar trajectory as monolingual acquisition (Montrul, 2008). However, this is not the case for learners

[2] The term 'heritage speaker' can also refer to individuals who switch their preference from their minority native language to the majority societal language (i.e., the L2) which then becomes their dominant language (Valdes, 2000).

of a second language including those who acquire a second language in childhood. It is suggested that acquisition of linguistic knowledge across the domains of phonology, morphosyntax and vocabulary progresses gradually for this population with initial utterances appearing short and formulaic (Halgunseth, 2009; Tabors, 2006). After some months sequential bilingual children can show signs of effective communication but are far from the linguistic level of their age-matched monolingual peers (Paradis 2019; Tabors, 2006). It is thought that adequate exposure to a second language generally results in its proficiency but that this can take up to 3 to 5 years to reach (Paradis, 2011). However, in relation to academic performance, Tucker (1998) proposes that children acquiring a second language require more than 5 years' experience with the language before achieving appropriate proficiency levels. More recently, Paradis (2019) has suggested that many children acquiring a second language never reach monolingual levels. It has been shown that the second language proficiency of this population can vary greatly and may depend on the influence of internal and external factors known to strongly impact second language acquisition (e.g., age, quality and quantity of input, socio-economic status, and cognitive abilities), and it is these specific disparities which make the population a significantly heterogenous linguistic group (Paradis, 2011). These factors will be explored in detail in Chapter 2.

In relation to other language acquisition types, the sequential bilingual population differs in some definitive ways regarding biological, cognitive and input factors. As they begin language acquisition later, in comparison to first language acquirers, they are biologically and therefore cognitively more mature (Unsworth, 2005). This conceivably allows sequential bilinguals access to greater cognitive capacities associated with older ages in childhood (e.g., memory, attention, and executive functioning skills) (Baddeley, 1993; Cummins, 1981; Gathercole & Unsworth, 2005; Newport, 1990; Schneider et al., 2006) which may facilitate the language acquisition process. Additionally, sequential bilinguals have in place an already well-developed native language system which may impact how the additional language is acquired (Schwartz, 1994a). In contrast to adult second language acquisition, initial second language exposure in childhood remains within the confines of the so-called critical period for language acquisition (Penfield and Roberts, 1957; Lenneberg, 1967). This suggests acquisition through intrinsic processes which parallel the implicit learning mechanisms evident in first language acquisition (Lakshmanan, 1995). Conceivably this results in greater linguistic proficiency in comparison to those commencing second language learning in adulthood. Implicit learning mechanisms will be explored further in Section 2.2.1. Variation in input between sequential bilinguals in childhood and other language acquisition types can also be observed. For instance, in the early stages of sequential bilingualism the second language may receive less rich and complex linguistic input known to foster language development compared to the first language (Meisel, 2016). However, compared to second language adults who are typically exposed on a limited instructional basis, sequential bilinguals have opportunities for fuller and richer exposure through immersion at school and the associated academic activities such as reading in the second language. In addition, children will have the opportunity to play and attend social activities conducted in the second language which may include interaction with native-majority language speaking peers. Interaction through play can motivate children to practice their second language skills in supportive and encouraging environments where they have the chance to engage meaningfully with the language (Fassler, 1998; Piker, 2013).

1.4 Relevance of research in sequential bilingual acquisition

Over the past five decades, research interest in sequential bilingual acquisition has fluctuated. Despite a significant number of studies during the 1970s (see Gass & Selinker, 1994; Lakshmanan 1995; Larsen-Freeman & Long, 1991; and McLaughlin, 1978, for reviews), the amount of research investigating this population declined over the next two decades with most research shifting their focus to the adult second language population (Lakshmanan 1995). However, the past few decades have seen a continual and substantial growth in research on this population which has included investigating its initial state, parameter setting and resetting, access to universal grammar, the availability of functional categories, morphological variability, first language attrition, investigation of the similarities in language development with the speech and language impaired population, and the influence of extraneous factors (see Blom & Paradis, 2016; Chondrogianni, 2018; Haznedar & Gavruseva, 2008; Unsworth, 2005).

The extensive increase in research reflects in part the ever-increasing prevalence of this population (Grosjean, 2010) which in itself validates the study of this linguistic group as a distinct variety of bilingualism (Chondrogianni, 2018; Lakshmana, 2009; Rothman et al., 2016). From a practical standpoint, further understanding facilitates applied perspectives in educational and clinical settings where professionals working with this linguistic group require empirical evidence on language development which can facilitate guidance and in making appropriate recommendations (Paradis, 2011; Unsworth, 2005). In relation to the target structures in the present study, acquisition of more complex syntax (e.g., subordination and passive voice) and its written form is often obligatory in school and therefore is greatly relevant to academic abilities (Dabrowska & Street, 2006; O'Donnell, 1974; Purcell-Gates, 2001). Therefore, from an educational perspective, it is imperative to understand the linguistic knowledge, especially so in relation to complex language, that this population has available to them at different stages to be able to appropriately support their educational needs (Bedore et al., 2016).

In addition, due to the unique position which sequential bilingual acquisition enjoys-with similarities to both first language (implicit learning mechanisms) and adult second language (greater linguistic and cognitive maturity) acquisition, this population can be used to evaluate opposing arguments and controversial hypotheses made regarding language acquisition and linguistic theory (Chondrogianni, 2018; Haznedar & Gavruseva, 2008; Lakshmanan, 2009; Paradis, 2011; Schwartz, 2004a). For instance, theoretical investigations derived from the generative theory of language acquisition have examined age and whether innate language faculties can be accessed in second language acquisition or whether particular domains of grammar are subject to maturation in that they cannot be acquired in the same way as first language learners (Wexler, 1998). If the language acquired by sequential bilingual learners patterns similarly to first language learners then it can be argued that they have acquired the language by the same means, i.e. implicitly, like native speakers. However, if their linguistic behaviour is more similar to adult second language learners then it could be the case that access to the language faculty is hindered and that they acquire language on an explicit basis.

In addition, Lakshmanan (1994) suggests that researching maturation effects in this population can be considered to be even more enlightening than investigations of the first language. For instance, as acquisition of a native language follows a predictable trajectory of changes which parallels maturation and cognitive development and these factors develop concurrently, this can make it difficult to establish which source influences the changes which occur in the development of language (Snedeker et al., 2007). However, sequential bilingual learners tend to be at a later stage of cognitive maturity which means the cognitive mechanisms which develop concurrently in the first language are not an issue. Therefore, using this population in investigations of maturational effects facilitate disentangling non-linguistic influences of maturation like memory and perception from the development of language (Gass & Ard, 1980; Lakshmanan, 1994; Snedeker et al., 2007). Furthermore, the sequential bilingual learner population is ideally placed in providing valuable information on the association between language development and other factors thought to impact language learning (e.g. cognitive factors, input and socio-economic status) as these are characteristically varied for this population (Blom & Bosma, 2016). Therefore, these factors can be effectively measured making this language group ideal in determining the extralinguistic effects in language acquisition (Bybee, 2009; Paradis & Grüter, 2014). The following chapter will review the individual difference factors which impact bilingualism.

2. Literature review

2.1 Introduction

This chapter will focus on the variety of individual difference factors which have been shown to influence bilingual language acquisition beginning with a brief description of each factor before reviewing the literature on how each impacts language acquisition for the sequential bilingual population.

Acquisition of a second language typically presents with huge individual disparity among learners in regard to proficiency, an inconsistency commonly attributed to a myriad of factors thought to strongly impact language acquisition (Granena, 2014). The various factors significantly influencing language acquisition in bilinguals are often described as internal or external to the individual (Paradis, 2011; Unsworth et al., 2011). Factors which are said to affect the individual on an internal level are related to variables of biological, cognitive and psychological influence, such as age, memory, motivation; and influence from previously acquired language (Chondrogianni & Marinis, 2011; Paradis, 2007; Paradis, 2011).[3] External factors are those which refer to the experiential environmental context of language exposure which can include quality of language input comprising types of language environments and activities, the amount of language input established by length of exposure time to the target language or use of the language in different settings (e.g., at home with other family members, or in the community), socioeconomic status, and parental second language proficiency (Paradis 2007; Paradis, 2011). While some studies investigating internal and external factors examine their impact on linguistic proficiency separately, others include multiple factors in the analysis as typically it has been shown that more than one factor impacts language acquisition or that there is an interaction between these factors (e.g., Armon-Lotem et al., 2011; Chondrogianni & Marinis, 2011; De Cat, 2020; Paradis, 2011; Sorenson-Duncan, 2017; Unsworth, 2016a). In the present study, the impact of a range of internal and external factors on proficiency across linguistic domains will be investigated

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[3] The influence from the study participants' first language will not be measured as a predictor variable in the present study. All participants in the study have the same first language namely, Arabic. It could be the case that there will be variation between subjects' dialectal Arabic as many come from, or have familial origins in, different Arabic-speaking countries. However, differences between dialects will not be analysed in this study nonetheless in light of results this will be explored further in the discussion section.

simultaneously to observe the impact and interplay of factors on the sequential bilingual learner population.

The following section (2.2) will describe the internal factors which have been shown to impact language acquisition and review previous studies which have investigated these domains in the sequential bilingual population which includes age of onset (2.2.1), chronological age (2.2.2), working memory (2.2.4), and motivation (2.2.5). The subsequent section (2.3) will examine external factors including the impact of quantity of language exposure (2.3.1), more fine-grained measures of input (2.3.2), and distal input factors (2.3.3) including socio-economic status (2.3.3.1) and parental L2 proficiency (2.3.3.2). It should be noted that most of the studies examined as part of the literature review comprise measures of multiple factors (e.g., age and input) and are therefore reviewed under each associated section. The literature review will also include a section on cross-linguistic influence which, although not measured in the present study, is important to consider in L2 acquisition (2.4). Following this, the measurement of language proficiency and how this is carried out in sequential bilingual language studies is presented (2.5), focusing on lexical, morphological, and syntactic measures. The final section will summarise the chapter's findings (2.6).

2.2 Internal factors

This section will detail the internal factors of age, working memory and motivation. Firstly, the issue of age will be explored including how this is measured, the mechanisms which may underlie its impact in language learning, and seminal studies which have investigated its effect on language acquisition. Following this, research on age effects specifically focused on the linguistic domains relevant to the present study in the sequential bilingual population will be reviewed.

In studies of bilingualism, the influence of age can be measured in one of two ways: (1) from the point of first meaningful exposure to the target language, commonly referred to as age of onset of acquisition; and (2) from the time at which data collection occurs, often referred to as age at time of testing or chronological age (Chondrogianni & Marinis, 2011; Unsworth, 2005). Both types of measurement can provide unique and inter-related influences on how language acquisition manifests.

Due to the significant interest in critical phases for language acquisition, the majority of studies on age effects investigate the impact of age of onset; while measurements of chronological age can impart insights on the individual's current cognitive, linguistic or social features of language learning (Stevens, 2006). For the present study both age factors will be measured as part of the analyses on acquisition of the target linguistic structures. This section will begin by examining the issue of age of onset of acquisition.

2.2.1 Age of onset of acquisition

Variation in the linguistic proficiency of bilinguals is most commonly attributed to the differing ages at which the individual begins exposure to the second language. Age of onset is one of the most researched but controversial factors in bilingualism (for detailed reviews see: Herschensohn, 2007; and Muñoz & Singleton, 2011). Research on long-term age of onset effects in both first language and second language acquisition mostly shows that ultimately those who begin exposure earlier attain greater competence than those who begin later (e.g., Abrahamsson & Hyltenstam, 2009; Coppieters, 1987; Curtis, 1977; DeKeyser, 2000; Gleitman and Newport, 1995; Johnson and Newport, 1989, 1991; Oyama, 1976; Patkowski, 1980, 1994; Schachter, 1990; Schwartz, 2004a).) thus supporting an 'earlier is better' perspective for language acquisition. It has been proposed that the early age of onset advantage for language learning can be attributed to a critical period whereby linguistic proficiency is only possible if acquisition begins before a particular age (e.g., Johnson & Newport, 1989; Lenneberg, 1967; Meisel, 2008, 2009). Different cut-off points are proposed as to when the critical phase closes. In relation to the morphosyntactic domain, a comprehensive review of research on age of onset effects by Long (1990) concluded that native-like proficiency can be expected but not guaranteed for children with an age of onset between 0-6 years old, while proficiency for those with an age of onset between 7 and approximately 15 years old is still possible but less likely, and unattainable for those with an age of onset beyond 16 years old. However, some researchers caution that not all exposure at younger ages results in greater ultimate proficiency as not all cases of later exposure lead to reduced competence (e.g., Kinsella & Singleton, 2014; Muñoz & Singleton, 2007). Consequently, linguistic proficiency has been linked to other internal (e.g., chronological age, working memory, motivation, knowledge of the first language) and external (e.g., amount and richness of second language exposure, socioeconomic status) factors. Other influencing factors will be discussed later in the chapter. Nevertheless, overall, studies have shown that later ages of onset to second language acquisition are qualitatively different from both first language acquisition and second language acquisition which begins at an earlier age of onset. Second language acquisition which commences at a later age of onset is shown to differ in terms of its developmental trajectory, accuracy, and in the error types used, compared to what is typically found in language acquisition (Meisel, 1990).

As previously stated, the divergent acquisitional paths of early versus later ages of onset for language acquisition are commonly attributed to a critical period (Critical Period Hypothesis, Penfield and Roberts, 1959, Lenneberg, 1967). Lenneberg's (1967) proposal for a critical period for language acquisition was based on earlier work by Penfield and Roberts (1959) who posited that neural maturation led to a cumulative reduction in brain plasticity in which the brain was thought to become much more rigid after around nine years of age thereby affecting how the brain acquires information (Long, 1990). Although there are different interpretations of the Critical Period Hypothesis (see Hyltenstam & Abrahamsson, 2003), the main proposition is that young children have an advanced biological capability to acquire language in comparison to older individuals (Lenneberg, 1967). This is considered to be due to an innate optimal period which ranges from approximately two to five years of age which is followed by an offset phase which sees a reduction in the advanced biological capability of acquiring language at around adolescence thus causing language acquisition thereafter to become a more difficult process (Lenneberg, 1967; Meisel, 2011). However, while the Critical Period Hypothesis proposes substantial changes in language acquisition capacity around adolescence, others have found significant variation in the acquisition of morphosyntax occurring at much earlier ages (e.g., Johnson & Newport, 1989; Kroffke & Rothweiler, 2006; Meisel, 2008, 2009, 2016; Rothweiler, 2006; Sopata, 2010). For instance, Meisel (2016) investigated the impact of age of onset in the acquisition of grammatical gender by German first language children acquiring French as a second language. The study found that those with an age of onset to French between 2;8 and 3;6, generally performed like native French learners. In contrast, those with an age of onset between 3;7 and 4;0 performed like adult second language learners thus suggesting a critical period of 3;6 years old for this particular grammatical feature. In relation to particular linguistic phenomena, Eubank and Gregg (1995) suggest that subcomponents of broader linguistic domains may follow different developmental paths and individually may or may not have critical periods with their own optimal phases (see also Eubank & Gregg, 1999). Similarly, Meisel (2008) suggests that the critical period is better understood as a set of sensitive phases each of which has an optimal period for the integration of new knowledge and therefore, the optimal age of onset range will not be the same for different linguistic domains.

Expanding on the Critical Period Hypothesis under a generative linguistic perspective, the Fundamental Difference Hypothesis (Bley Vroman, 1990) proposes that the divergent acquisition paths between early and late ages of onset to language acquisition are grounded in the accessibility of universal grammar, which arguably becomes unavailable in line with the closing of the critical period. In acquisition of a first language, it is suggested that access to universal grammar facilitates optimal language development via implicit domain-specific linguistic mechanisms. Acquisition which occurs at a later stage around the close of the critical period (e.g., later second language acquisition) is obstructed in accessing universal grammar and therefore language acquisition must be operationalised through explicit domain-general cognitive mechanisms. Explicit knowledge involves language learning through problem-solving strategies, reflection on structures, and conscious effort (DeKeyser, 2000; Meisel, 2011; Montrul, 2009).

Implicit language learning is thought to be a key feature of language acquisition in both first language acquisition and second language acquisition in childhood (DeKeyser 2000, 2003; M. Paradis 2004; Ullman 2001). This is attained from language encounters as opposed to explicit rule learning and is associated with unconscious and automatic acquisition (Ellis, 2009). In contrast, explicit learning appears to be a feature of older language learners (especially adults although adolescents and older children may also fall within this category) and relies on cognitive mechanisms for learning language. According to Ullman (2001), the two language learning styles are connected with two different parts of the brain: implicit learning is connected with the left frontal lobe while explicit learning is linked with the medial temporal lobe. While implicit language mechanisms are often linked with language acquisition in childhood it has also been shown that many adult language learners achieve native-like proficiency in a second language (e.g., Birdsong, 1992). This has led some researchers to consider that some adult learners also demonstrate implicit language learning strategies and are therefore able to access implicit means for learning a second language (Sagarra & Herschensohn, 2010). This has been associated with the perspective that brain plasticity is maintained into adulthood (Osterhout et al., 2006). Furthermore, younger children may also make use of explicit means for learning language. For instance, Lichtman (2016) showed that children engage in explicit language learning mechanisms similar to adults when taught an artificial mini language through explicit instructional means. Therefore, it is possible that a more nuanced distinction between implicit and explicit language learning is needed to take account of crossovers in language learning mechanisms between child and adult learners (Herschensohn, 2007).

The following section will explore previous research which has investigated age of onset effects retrospectively.

2.2.1.1 Age of onset – retrospective studies

Age of onset effects have often focused on contrasting the language proficiency between different ages of onset. Some research has involved the exceptionally rare cases of child isolation the outcomes of which suggest the presence of qualitatively different forms of language acquisition and proficiency for later ages of onset (e.g., Curtiss, 1977; Davis, 1947).[4] Other research focuses on

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[4] Two notable instances of child isolation which relate to the current study in that each constitutes a case of an early and a late stage of age of onset in childhood (albeit the later stage is within early adolescence), are that of ‘Genie’ and ‘Isabelle’. Both cases involved children who experienced little if any linguistic input during childhood. Genie (Curtiss, 1977) was isolated until nearly 14 years old and although she developed competent lexical ability, even after significant linguistic input she was unable to master the morphosyntactic properties of L1 English. In contrast to Genie, Isabelle (Davis, 1947), who began exposure to language at approximately age 6;6, was able to acquire all linguistic abilities equal to her age-matched peers subsequent to two years of intensive linguistic exposure (Davis, 1947; Gleitman and Newport, 1995). Although Davis’ report on Isabelle does not mention specific linguistic domains, having a normal level for her age suggests that her linguistic ability was adequate across all language areas. The contrasts between these findings appear to support the critical period perspective for language acquisition suggesting that for L1 acquisition an earlier age of onset to language results in more proficient acquisition in the morphosyntactic domain (Herschensohn, 2007). However, Newport (2006) cautions including results from cases of isolation as evidence for age of onset and/or critical period effects as the neglect experienced by the individual may have affected wider cognitive and neural faculties resulting in deficits impacting linguistic processing thus confounding results and rendering these data somewhat unreliable.

differences in the ages of onset of two different linguistic groups: one is typically developing individuals acquiring a second language; and the other is the hearing-impaired population acquiring sign language often after receiving cochlear implantation. This review will focus on the former type of research namely, second language acquisition in typically developing individuals (for age of onset effects in the hearing-impaired population see among others: Colletti et al., 2011; Friedmann & Rusou, 2015; Geers et al., 2009; and Moreno-Torres et al., 2016).

One frequently cited study from second language acquisition is Johnson and Newport (1989). Results showed that of the 46 first language Chinese and Korean participants in their study acquiring English as a second language, those with an age of arrival to the united States before age 8 achieved native-like proficiency on an extensive range of grammaticality judgement tasks evaluating morphosyntactic structures (past tense, plurals, third person singular, present progressive, determiners, pronominalisation, particle movement, subcategorization, auxiliaries, yes/no questions, word order, and wh-questions). In contrast, those with an age of arrival after age 15 achieved much lower scores which were highly variable among the participants. From this, the authors concluded that an age of onset in second language acquisition before age 15 positively impacted linguistic outcomes therefore supporting an 'earlier is better' perspective for acquisition of a second language. Furthermore, this lends credence to the view that a critical period exists for language acquisition closing around adolescence.

Johnson and Newport's study has been criticised for a number of methodological limitations which include having participants with differing first languages, insufficient lengths in exposure to the second language for ultimate attainment levels to be reached, varied second language input, and an excessively long duration of testing which may have affected participants' concentration levels (Bialystok and Hakuta, 1994). However, a later study by DeKeyser (2000) which addressed the methodological limitations by including participants from one language background (Hungarian) with all having had a long period of residence in the United States (at least 10 years) and using a shorter version of Johnson and Newport's test of morphosyntax. DeKeyser's findings were consistent with those of the original study in that an earlier age of onset resulted in higher proficiency than those with a later age of onset. In another study by Flege et al (1999), initial results on grammaticality judgement tests by first language Korean speakers acquiring English as a second language mirrored those found by Johnson and Newport (1989) and DeKeyser (2000) (i.e., grammaticality judgements weakened as the age of onset increased). However, when they controlled for other influencing factors using subgroups matched on variables of language use and access to education, the age of onset effect became insignificant. This highlights the importance of accounting for other factors which may confound age effects, something that has been central to the design of this project. In addition, while Johnson and Newport (1989) reported that length of exposure was not a significant factor in their data, the study did not take account of differences in the various types of exposure the participants may well have experienced (e.g., socio-economic background, exposure from native speakers, and participation in sports or social activities where the second language is used). The impact of types of language exposure will be explored in more detail in Section 2.3.

Another discrepancy in research reporting critical period effects is that some later age of onset participants do in fact demonstrate native-like or very high linguistic ability in comparison to younger learners. In a study by Birdsong (1992), in which he replicated an earlier study by Coppieters (1987), he found that when subjects are considered individually, many of the late language learners performed as well as those who started acquiring the language at a younger age. DeKeyser's (2000) study also revealed that some older age of onset participants who began their acquisition after puberty scored similarly to younger age of onset learners. DeKeyser reconciles the divergent pattern by proposing that in these cases the participants presented with higher levels of verbal analytical skills and working memory which increased their individual second language competency. Cognitive mechanisms related to working memory as a case of individual variation in second language learning will be discussed in Section 2.2.4.

The research presented thus far includes studies which have examined age of onset retrospectively (i.e., the participants have been tested in adulthood) which may make it difficult to account for other factors that influence language learning (e.g., language exposure effects). The following section will review research investigating age of onset in sequential bilingualism in childhood, the population under consideration in the current study. This will include investigating the linguistic domains related to those which will be measured as part of the present study: vocabulary, morphology, and syntax.

2.2.1.2 Age of onset effects in sequential bilingual acquisition

Research on lexical development in sequential bilingual acquisition generally shows a positive correlation between age of onset (i.e., an older age of onset) for both receptive (e.g., Blom & Bosma, 2016; Golberg et al., 2008) and expressive (e.g., Blom & Bosma, 2016) lexical proficiency. According to Paradis (2007), older children with more advanced cognitive and linguistic abilities may be able to utilise their more developed existing conceptual–lexical mappings allowing them to accrue vocabulary more quickly. However, findings in a study by Unsworth (2016a) contrast the above results. An important aspect of Unsworth's analysis was to control for the impact of other influencing factors which included age at time of testing and using a cumulative measurement of length of exposure (calculated daily length of exposure over the course of the child's life) rather than the traditional length of exposure measure (i.e., taking the participant's age of onset from their current age). Once these variables were controlled for, the study found there was no significant age of onset differences between the younger age of onset group (age of onset below age 4) and the older age of onset group (age of onset above age 4) in their vocabulary scores. This result highlights the importance of including measures which take account of other variables which may confound the age factor such as linguistic exposure. The issue of length of exposure and input factors and how these have been measured, will be explored further in Section 2.3.

In relation to morphological proficiency some research on age of onset effects shows a positive association (Blom & Paradis, 2015) while others show limited or no effects (Blom & Bosma, 2016; Paradis & Blom, 2016; Snedeker et al., 2007; Unsworth, 2016a). In contrast, others have found a younger age of onset advantage (Jia & Fuse, 2007). In Blom and Paradis' (2015) study, which focused on acquisition of inflectional morphology by child second language (L2) learners with and without specific language impairments (SLI), they examined age of onset effects in the use of third person singular and regular past tense on probes from the Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001). A logistic mixed regression analysis of responses by the typically developing child L2 learners found that children who began their exposure to English later made fewer omission errors in the target inflectional morphology than those who began exposure at a younger age. The positive age of onset effect was also reflected in the SLI group. Therefore, results suggest that increased age of onset predicts better outcomes for regular tense inflection. The authors propose that this outcome is related to the greater underlying cognitive resources of older children such as higher working memory capacities.

In Paradis and Blom's study (2016), they compared the proficiency of morphological inflection between bilingual children whose age of onset to the L2 was either younger or older than age 4;0. Although the main impetus for the study was to investigate whether earlier or later age of onset groups revealed equal use of the BE morpheme and inflectional verbal morphology, the researchers contrasted accuracy of the target morphemes between the two cohorts. The two participant groups completed production and grammaticality judgement probes targeting morphological inflection and BE morphemes. The younger group had lower scores for the target morphology compared to the older group (.51 and .60 respectively), while the older group had slightly lower BE scores than the younger group (.71 and .74, respectively). The results in relation to inflectional morphology reflect those of the previous study (Blom & Paradis, 2015) whereby an older age of L2 onset positively correlates with proficiency; however, they suggest a more limited association between age and acquisition of the BE morpheme, again highlighting a very complex picture.

Limited age effects were also found in Blom & Bosma (2016) which investigated the acquisition of Dutch L2 inflection by Frisian L1 children to ascertain whether there was age of onset effects during early child L2 acquisition. Participants were aged between 5-6 years old at time of testing but had differing age of onset to Dutch ranging from one to four years old. To measure inflectional accuracy the researchers administered a subtest of the Taaltoets alle kinderen (TAK, 'Language assessment for all children', Verhoeven & Vermeer, 2002). The TAK is an elicitation task with 24 items testing 12 constructions of the plural form with nouns and 12 participle constructions with verbs. Incorrect items were based on the omission of inflectional forms or the use of commission errors. The data were analysed using mixed logistic regression modelling. Age of onset was a significant predictor with older age of onset children achieving better accuracy than younger age of onset children. However, the authors note that this effect was only relevant to a small subset of the data and when an analysis was conducted on the smaller but more balanced corpora the age of onset effect did not manifest as a significant predictor variable. Consequently, the researchers determine that an older age of onset is somewhat related to a positive outcome, but that this influence is limited. However, the authors caution that age of onset may have been highly confounded with length of exposure which was measured on the basis of an overall length of exposure rather than a more fine-grained measure (e.g., including a calculation of the participant's daily exposure). Furthermore, as noted by the authors, the age of onset range included in the study is somewhat narrow (being between zero and four years old) and can therefore not account for the presence of age of onset effects over a more extensive age range.

In contrast to the previously reviewed studies, research by Snedeker et al. (2007) found no significant age of onset effects in acquisition of morphology. This study measured age of onset effects with a somewhat different but related population to sequential bilingual children. Their study focused on internationally adopted pre-school children originally from China who were adopted to the US. The children were adopted between the ages 2;7 and 5;6 and were compared to non-adopted monolingual age-matched children. The study examined a number of linguistic domains of L2 English and how these developed over time, one area being acquisition of inflectional morphology. Data were collected from 27 participants through speech samples which were recorded every 3 months, 3 to 18 months after adoption. The accuracy of morphology was measured using the MacArthur-Bates Communicative Development Inventory 2 (CDI-2; Fenson et al., 1993). This tool, part of which enquires about the child's use of inflectional morphology, was completed by the parents. Parents also recorded speech samples which were then transcribed by the researchers and compared to parental reports. The authors state that parental accounts accurately reflected the morphosyntax of the children's speech. The study reports that in line with monolingual infants, in the early stages of acquisition, the children produced utterances that lacked inflectional morphology but that accuracy gradually improved as their vocabulary size grew. Findings showed that morphological acquisition was not predicted by age of onset as there was no difference between the non-adopted infants and the internationally adopted older children. This signified that the higher cognitive development of older age of onset learners does not influence morphological development during early childhood. It was noted however that the adoptees, although going through the same linguistic stages as monolingual infants, appeared to do this much more quickly therefore, an older age of onset did in fact affect speed of acquisition. As the authors note, this may highlight development of domain-general processes such as association, generalization, recognition, and recall, which influence rate of learning. This was related to the possibility that older children may require a reduced amount of exposure to link a concept and encode and retain it. The results of this study highlight important findings regarding age of onset effects in early childhood. However, in relation to the present study and the sequential bilingual population under consideration, the results are perhaps somewhat dissociated. As noted by Snedeker and colleagues, this is due to the fact that language input in each case comprise different forms: being at younger ages, internationally adopted pre-schoolers will generally receive the majority of their L2 input from their parents or family members at home, while the sequential bilingual population typically acquire L2 linguistic exposure from the school environment.

Unsworth's (2016) study investigated age of onset effects in acquisition of L2 Dutch between two different age groups (average age of onset of 2;4, for the younger group, and 5;5 for the older group) of L1 English speaking children. Verb morphology was tested using an elicited production task. Findings showed that there were no significant differences between the two age of onset groups on verb morphology as the children with an age of onset over 4 years of age did not produce significantly more errors than those starting L2 exposure before age 4. This result held when other influencing factors such as age at testing, cumulative length of exposure, and current amount of exposure were controlled for. Unsworth states that overall, the participants' error types reflect those of L1 children in regard to verb morphology. Therefore, this study does not support an earlier age of onset advantage for expressive morphology and furthermore, results suggest acquisition of morphology for bilinguals appears to follow a similar pattern to native language acquirers.

While the previous studies have investigated morphological proficiency in sequential bilingualism at one point in time or in a small number of sessions over a short period of time, a study by Jia and Fuse (2007) examined the acquisition of inflectional morphology longitudinally. Proficiency in using six inflectional morphemes (third person singular, copula BE, regular and irregular past forms, progressive aspect, and DO) was examined. Participants comprised 10 L1 Mandarin speaking children and adolescents who had arrived in the US at different ages between 6 and 15 years old. Data were collected over a five-year period through spontaneous speech samples recorded during conversations with each participant as well as an elicitation task for the progressive morpheme. These were subsequently transcribed and coded for production of target morphology. Coding involved identifying the total number of obligatory contexts for each morpheme to ascertain the percentage of correct morphemes produced. Obligatory contexts involved instances where the production of the morpheme was required for the sentence to be grammatically well-formed. Findings revealed that an earlier age of L2 onset partially predicted morphological proficiency however, they stated that outcomes took several years to develop and only occurred for two morphemes (third person singular and regular past tense morphology). Moreover, the researchers noted that initially there appeared to be an older age of onset advantage lasting until between the first and second year of exposure after which the trend reversed and the earlier age of onset participants showed greater proficiency in morphological production (for third person singular and regular past tense morphology). Although the authors state that this age of onset effect was not statistically significant for all morphemes, there was a consistent negative trend indicating an earlier age of onset advantage over time. Despite the study finding an earlier age of onset advantage, it also found that participants performed similarly in their production of morphology (proficiency and error types used) across the age of onset groups. Due to these similarities among individuals with different ages of onset, the investigators suggested that the study failed to generate support for sensitive period effects (if age of onset impacted acquisition of morphological features, then it would be expected that differences in proficiency and error types would manifest depending on when the participants began to acquire L2 English-younger versus older ages of onset). In addition, the small participant sample size used in this study (10 participants) may mean that the findings may not be generalisable (although there appeared to be a large database as a number of sessions were recorded and transcribed over 5 years for each participant). In addition, as the older participants in this study were adolescents at age of L2 onset it may be the case that this finding would not be replicated for participants who all began acquiring the additional language in childhood such as those in the current study.

In summary, while some studies have found an older age of onset to be more advantageous for morphological proficiency (Blom & Paradis, 2015; Paradis & Blom, 2016) others have found limited (Snedeker et al., 2007; Blom & Bosma, 2016) or no impact (Unsworth, 2016a). However, research conducted longitudinally has revealed a younger age of onset advantage manifesting after two years of exposure to the second language for some morphological features (Jia & Fuse, 2007). Therefore, results for morphological proficiency between studies are mixed. The following paragraphs will review studies which have investigated age of onset effects on the proficiency of syntactic structures in sequential bilingual acquisition.

The role of age of onset (and age at time of testing) in the sequential bilingual acquisition of wh-questions, passives, and relative clauses was investigated in a study by Armon-Lotem et al. (2011). Participants included 65 first language Russian–second language German and 78 first language Russian–second language Hebrew children. Use of complex structures was tested at 6 different sessions using sentence repetition tasks. Using sentence repetition tasks to assess proficiency of target sentences, age of onset was found to have a significantly negative impact in relation to second language Hebrew participants therefore showing an earlier age of onset advantage for this cohort. An age of onset below age 2 reflected monolingual norms while those with an age of onset after age 3 performed 1.5 standard deviations below monolingual norms. In contrast, no age of onset effects were found for the German L2 children. However, this was likely associated with the much narrower age of onset range for this cohort (18 months, compared to 66 months for the L2 Hebrew children). This highlights the importance of including a wide enough range of ages to capture age effects[5]. In relation to the German L2 children, it was chronological age that significantly predicted performance on all complex structures. The impact of chronological age for this group will be discussed in Section 2.2.2.

Bedore et al. (2016) evaluated age of onset effects on the language performance of Spanish–English bilingual children who included first-graders

[5] Participants with a wide range of ages of L2 onset were included in the current study to be able to appropriately capture age of onset effects.

(average age: 6;8) (N= 586) and third-graders (average age: 8;8) (N= 298). Participants' production and interpretation of English target measures included morphology (third person singular, regular and irregular past, copula), prepositional phrases, passive voice, negatives, and question inversion. This was captured using the Bilingual English Spanish Assessment–Middle Elementary (BESA, Peña et al., 2010). Results indicated that earlier exposure to L2 English significantly predicted higher performance for both the younger (first-graders) and older (third graders) children. However, the impact of age of L2 onset was much stronger for the first-graders compared to the third-graders. The authors propose this occurred due to the increased length of exposure to English the older children had thereby indicating that as length of exposure increases, the importance of age of L2 onset decreases. Additionally, as the authors concede, findings for age of onset effects were undermined due to the high correlation with length of exposure to English. Thus, it is possible that what was observed was a length of exposure effect rather than an effect of age of onset. In addition, the results for all structures were reported globally (i.e., together) so it is not known if a separate analysis of scores for specific complex measures (passives, negatives, and question inversion) may have produced a different outcome.

In a study by Chondrogianni and Marinis (2011) they also used a standardised test (the Diagnostic Evaluation of Language Variation, DELV; Seymour et al., 2005). The syntax component of the DELV assessed comprehension of wh-questions and passive voice sentence structures which included 10 items evaluating each structure. Participants were 43 L1 Turkish children aged 6;2 to 9;8 acquiring English with L2 length of exposure between 1;10 and 6;8 years. In administering the DELV subjects are given a sentence-picture matching task comprising a sentence with the target structure and three different pictorial choices from which they had to choose the picture which matches the sentence given (Roeper, 2004). Findings revealed limited age of onset effects with passive voice and wh-question structures only correlated to a low degree with a younger age of L2 onset.

Roesch and Chondrogianni (2016) examined the acquisition of subject and object German which questions by two groups of French-German child bilinguals (simultaneous bilinguals and early second language children) aged between 4 and 5 years old. As in Chondrogianni and Marinis (2011), the study used a picture selection task although in this case only one picture per sentence was shown (pictures were adapted from Adani, 2011 and Friedmann et al, 2009) which depicted three animals performing the same action on each other (two animals on the right and left of the picture were of the same type and one animal in the middle was of a different type). One character in the picture is the agent or patient as depicted by the verb and the participant must choose the target character as per the sentence given. Repeated measures analysis of variance showed that the simultaneous bilingual group had better accuracy in comprehending subject and object wh-questions when these contained nominative and accusative case marking compared to the early second language group. Therefore, an earlier age of onset (i.e., acquiring the language as a simultaneous bilingual) resulted in better understanding of target structures compared to a later age of onset (i.e., acquiring the language at a later stage in childhood). However, as the earlier age of onset learners in this case were simultaneous bilinguals (i.e., beginning acquisition from around birth) it may be the case that this finding would not be reproduced for those beginning acquisition of an additional language at a later stage in childhood such as those in the present study.

Nishikawa's (2014) study investigated age of onset effects in the acquisition of L2 Japanese relative clauses by 47 learners with various L1 backgrounds and ages of first exposure to the L2. Although most participants' age at testing fell within the young teenage range (mean age at time of testing 13;1), all began their exposure in childhood (mean age of onset 4;1). The target language proficiency of participants was examined using three different means: impressionistic judgments, and a relative clause comprehension and a production task. The initial results from the impressionistic judgments showed an advantage for the younger L2 starters. And even though the relative clause comprehension and production tasks found that native-like proficiency is not guaranteed even for very early child second language starters, the results demonstrated that earlier exposure results in higher proficiency. However, the length of exposure to the target language varied widely between participants and may have confounded results. In addition, the inclusion of participants with various L1 backgrounds means that it is possible that transfer effects influenced learners' responses. It has been shown that prior first language knowledge of relative clause structures can transfer to acquisition of the second language (e.g., Kidd et al., 2015).

In contrast to the preceding research studies finding a positive association with a younger age of onset, Rothman et al. (2016) found the opposite effect for interpretation of passive voice sentences. In this case the impact of language exposure including the length of L2 input, the L2 exposure environment, and socioeconomic status, were strictly controlled as was the L1 background and L2 proficiency levels. All participants were Spanish speaking children from affluent backgrounds and attended the same school in which they received L2 English instruction. The participants were placed into one of two groups depending on their age of initial exposure to English (younger group: 3;0–4;0; older group: 6;0-7;0). Interpretation of active and passive voice sentences were evaluated through a picture-matching task which was repeated three times with a year between each testing session so that the development and mastery of target structures could be gauged longitudinally. Puppets were used to narrate and guide the experiment, and pictures used contained characters from a popular children's cartoon. Four verbs (kick, kiss, touch, find) were used in a 4 × 4 design. Results indicated that while both the younger and older age of onset groups comprehended the active sentences, in the initial stages of acquisition both groups had more difficulties with the passive structures. At the next session, the older group reached ceiling on passives. However, the younger group took another year to reach the same level of proficiency for this structure. These results suggest that the greater cognitive and linguistic development associated with an older age of L2 onset is advantageous for comprehension of the passive voice structure. However, the task employed in this study may have influenced results. As children were required to parse the target sentence while processing the actions within multiple pictures, it could be argued that this task advantaged the older age of onset children who were 3 years older (chronologically) compared to the younger age of onset group. Task effects are important to consider when investigating the impact of different ages and this will be explored further in Section 2.4. The task chosen for the current study and its impact of cognitive demands will be discussed in the methodology chapter.

A study by Unsworth (2016a) investigated production of direct object scrambling in L2 Dutch by L1 English speaking children. Although Dutch has a somewhat strict word order it does allow both base and scrambled forms. The term object scrambling describes word orders which are 'scrambled' or rearranged from base word orders. Participants comprised two groups: the younger group had an average age of onset of 2;4 (age at time of testing of 7;3) while the older group had an average age of onset of 5;5 (age at time of testing of 9;1). The task used to evaluate direct object scrambling comprised a truth-value judgement task (based on Krämer, 2000, and adapted by Unsworth et al., 2010). Participants were presented with a story consistent with interpretations of the relevant indefinite object and then a puppet was asked to describe what had happened in the story and the child had to judge the truthfulness of the puppet's statement. As with the findings of this study in relation to vocabulary and morphology, once age at testing, (cumulative) length of exposure, and current amount of exposure were controlled for, analysis of covariance revealed there was no significant difference between the age of onset groups (age of onset below age 4 versus age of onset above age 4).

A study by Paradis et al. (2017) also found no impact for age of L2 onset. This study examined production of relative clauses alongside coordinate, complement, and adverbial clauses, but found that age of L2 onset did not impact proficiency of these sentences. However, the authors acknowledge that the age of onset ranges included (4;7 to 5;5) may have been too narrow to observe any impact for this measure. As per an earlier cited study (Blom & Bosma, 2016), this highlights the importance of including a wide enough range of ages to be able to adequately measure an age impact.

In summary, findings suggest that overall, an older age of L2 onset predicts lexical range (Snedeker et al., 2007; Golberg et al., 2007; Blom & Bosma, 2016). However, its impact is less robust in the morphosyntactic domain. Results have demonstrated both positive (e.g., Snow & Hoefnagel-Hohle, 1978; Paradis, 2011; Blom & Paradis, 2015), negative (Jia & Fuse; 2007), and limited or no effects (e.g., Snedeker et al., 2007; Blom & Bosma, 2016; Paradis & Blom, 2016; Unsworth, 2016a) for morphology. A similar picture is shown for syntactic structures with some revealing a younger age of L2 onset advantage (e.g., Bedore et al., 2016; Nishikawa, 2014; Roesch & Chondrogianni, 2016), others an older age of L2 onset advantage (e.g., Rothman et al., 2016), and others demonstrating no impact (Paradis et al., 2017; Unsworth, 2016). However, differences in methodologies including ranges of ages, tasks used to measure target language, whether language exposure was controlled, and the inclusion of participants with various L1s, may have confounded results. This discrepancy in previous literature has been a key influence in our choice of experimental design in the current study and has also directly informed our research questions. We will come back to those in Section 3.7.

2.2.2 Chronological age

As mentioned in the introductory section on internal factors, while age of onset can provide insight on critical period effects, chronological age is often measured to impart understanding on the impact of current cognitive, linguistic or social features of language learning (Stevens, 2006). The influence of chronological age or age at time of testing in language acquisition is associated with greater cognitive, linguistic (through experience with the first language), and social development. These different aspects will be considered below.

Chronological age is intrinsically linked to the biological development of cognitive capacities and its variation at different ages (Gathercole & Baddeley, 1993). Some researchers suggest that cognitive capacity, encompassing memory, attention, analytic reasoning, executive control and metalinguistic awareness, aids the acquisition and processing of language (e.g., de Villiers, 2007; Harley & Hart, 1997; Long & Rothman, 2014; Paradis, 2011; Paradis et al, 2017; Szmalec, et al, 2012; Tsimpli, 2014). Differences in cognitive capacity in childhood are associated with different stages of child development which sees substantial increases in cognitive mechanisms as a function of age throughout the early years until adolescence (Blom & Paradis, 2015; Gathercole, 1999; Gathercole, 2006; Paradis, 2011). In relation to second language learning, Cummins (1981) suggests that the greater cognitive development of older child second language learners licenses higher ability of the cognitive properties which constrain perception and memory, consequently facilitating an advancement in processing language. Furthermore, Newport (1990) proposes that age-related differences in cognitive functioning mean that older learners with more developed cognitive capacities, require less time in building a stock of stored patterns from which they can generalize. The greater cognitive development of older second language learners is associated with the faster development of linguistic proficiency in the initial stages of second language acquisition also known as the rate advantage. Children at older ages also have more experience with language in general through familiarity and involvement with their native language which supports metalinguistic awareness. In terms of L2 acquisition this may facilitate particular conceptual-lexical mappings if these have already been established in the L1 (Paradis, 2007).

As well as biological factors, individuals at different chronological ages will also vary in terms to their lifecycle stage which may be linked to sociocultural experiences of language learning such as social development, motivation for learning, and the opportunities to use and support second language competence (Stevens, 2006). According to Gee (1996) language acquisition is fundamentally a social process and therefore can be influenced by how the individual interacts in the second language including the status they give to the new language, who they communicate with in the second language, and how often they use it. McKay (2006, p.29) proposes that the social aspect of language development allows individuals,

> “to create meaningful communication tied to new social and cultural contexts, learn new cultural codes, establish new identities, and acquire specific discourses related to the school curriculum”.

Age differences have been shown to impact this socio-cultural perspective of second language in children due to variation in social abilities and peer and cultural preferences. For instance, Jia and Aaronson (2003) found that older children compared to younger children have less restrictions in relation to the places they can go and therefore spend more time attending activities and clubs outside of school affording them greater access to richer second language experiences. Peer preference is also a factor considered to influence language development differently in childhood depending on age. Older children are thought to form friendships based on how comparable others are to themselves in relation to cultural similarities (e.g., ethnicity, social class, gender) (Hartup, 1996; Kupersmidt et al., 1995), while younger children are shown to form friendships based on specific activities therefore, younger children may have more friends from various social and cultural backgrounds. These divergent peer preferences may mean that older sequential bilingual children who seek out more friendships with those who are culturally and therefore, possibly more linguistically similar, may have more restricted second language experiences (Jia & Aaronson, 2003). In contrast, younger sequential bilingual children whose friendships may be more culturally and linguistically diverse may mean they interact more in the second language therefore enhancing their second language experiences (Jia & Aaronson, 2003).

In addition, age effects may also manifest through an interaction with prior linguistic knowledge. This knowledge is thought to be a crucial source which learners rely on to facilitate the task of second language learning and is considered to be operational from the start of second language acquisition until proficiency is reached (Ellis, 1997; Jarvis & Odlin, 2000). Influence from the first language can be exhibited in different ways including the direct transfer of an L1 structure to the L2, preference for a structure in the second language that parallels the first language, or avoidance of a structure that contrasts with the L1 structure for the same concept (Odlin, 2005). The manifestation of this influence (which may involve the use of target-deviant structures) in sequential bilingualism may be impacted by the different maturational and cognitive stages of the individual (Chondrogianni & Vasic, 2016). For instance, Bialystok and Miller (1999) suggest that younger L2 learners are more adept at restructuring a category to fit the new linguistic data in the input, possibly due to particular language learning mechanisms (i.e., implicit mechanisms) which older learners may not have. In addition, Kuhl et al. (2016) suggest that as older learners are inclined to have had more first language learning, this may allow the first language to become more stabilised and compete with the second language structures making learning the second language more difficult and possibly leading to more cross-linguistic influence and therefore more target-deviant like structures. Odlin (2005) notes that while older second language learners tend to have higher cognitive abilities and use more explicit learning strategies which may help utilise deductive reasoning and problem solving mechanisms in analysing unfamiliar grammatical patterns in the second language, the effort needed by neural resources to process such analyses may make it more difficult to undertake these approaches to learning. However, in a recent study by Pfenninger and Singleton (2016) they found that there were no differences in influence from the first language in the domain of morphosyntax between younger and older age of onset learners; ultimately, the older starters were not more prone to transfer than the early starters. The following section will review research investigating the impact of chronological age on lexical, morphological, and syntactic domains in child sequential bilingualism.

2.2.2.1 Chronological age effects in sequential bilingual acquisition

As with age of onset effects and vocabulary, research on lexical development in sequential bilingual language acquisition generally shows a positive correlation between chronological age and lexical proficiency (e.g., Snow & Hoefnagel-Hohle, 1978; Paradis, 2011; Snedeker et al., 2012). As mentioned previously, these findings are often attributed to increases in cognitive capacities (i.e., memory, attention, analytic reasoning, executive control and metalinguistic awareness) and greater overall linguistic experience characterised by older ages in childhood (Cummins, 1981). However, findings on morphological proficiency are much more mixed with some finding a positive impact (Snow & Hoefnagel-Hohle, 1978; Snedeker et al., 2007; Paradis, 2011) and others revealing no effect (e.g., Chrondrogianni & Marinis, 2011). This is expected since morphology, and morphological complexity, varies a lot cross-linguistically (i.e., the system that is being acquired might be morphologically very complex or very simple). In terms of syntactic measures, while some studies have found an advantage for older chronological age in relation to sentence structures (e.g., Bohman et al., 2010; Paradis et al., 2017), in others this has depended on the particular second language under investigation (e.g., Armon-Lotem et al., 2011), and in others more advanced statistical analysis demonstrated no effect for this factor (e.g., Chondrogianni & Marinis, 2011).

A seminal study which suggests an advantage for older L2 learners is Snow and Hoefnagel-Hohle (1978). Participants included both beginner and advanced cohorts divided into a number of different age brackets. The beginner cohort included the following age groups: 3-5-year-olds, 6-7-year-olds, 8-10-year-olds, 12-15-year-olds, and an adult group; while the advanced group comprised 6-7-year-olds, 8-10-year-olds, 12-15-year-olds, and an adult group. In this study they administered a comprehensive range of tests three times over the course of a year which evaluated a number of linguistic domains (pronunciation, vocabulary, morphology, and grammar). In relation to the adolescent and child groups, findings indicated the same high to low sequence for all tasks except pronunciation: the 12-

15 year olds were the most proficient learners, followed by the 8-10 year olds, then the 6-7 year olds, with the weakest group being the 3-5 year olds. Findings suggest that in the early stages of language acquisition older children and adolescents are superior to younger children. However, it could be said that the types of tasks used in the study favoured the older learners. For instance, the task used to evaluate morphology (Berko's ‘Wug test’, 1958) assessed the subject’s ability to apply morphological rules to new ‘nonsense’ words. However, as the same test was administered in each of the sessions, it could be argued that the older groups were able to utilise superior cognitive-memory skills proposed to be evident with increased age, allowing them to reanalyse and retrieve responses from previous tests (Cummins, 1981).

A study by Paradis (2011) also demonstrated an older age advantage for production of morphology. This included L2 English third person singular, regular and irregular past tense, copula and auxiliary BE, and auxiliary DO, using the TEGI. Participants were aged 4;10-7;0 and had various L1 backgrounds. Production of third person singular, regular and irregular past tense using the TEGI was also investigated by Chondrogianni and Marinis (2011). While chronological age was correlated with greater morphological accuracy it was not found to be a significant variable on further analysis using multiple regression analysis. The same study found a similar picture for accuracy of wh-questions and passive voice as measured by way of the DELV standardised assessment. While a correlation analysis revealed that age at time of testing was associated with greater accuracy, this factor was noted to be highly correlated with length of exposure. On selecting significant variables for entry into a multiple regression analysis, chronological age was found to be non-significant and was therefore removed from further analysis.

This highlights two important aspects of language research: controlling for inter-related factors (such as factors of time – chronological age, age of L2 onset, and length of exposure) which may have a confounding effect on results; and administering a more sophisticated statistical analysis. While correlations can impart information regarding general trends between a factor and accuracy, it may be the case that collinearity between variables means that a related but unintended predictor drives the relationship between the dependent variable and the target factor.

Advanced statistical evaluation which can address some of the issues of collinearity will ultimately determine more robust findings on the impact of factors.

As mentioned in the previous section on age of onset effects, Armon-Lotem et al. (2011) investigated wh-questions, passives, and relative clauses as part of a range of measures in two cohorts of Russian L1 children who differed in relation to their L2 (German and Hebrew). The study found that chronological age only impacted use of these structures for the German L2 children. However, as noted by the authors, since the chronological age of the Hebrew L2 group included a narrow range of ages (54-81 months) this may not have been sufficient enough to capture any effect in relation to this factor.

A large-scale study of 756 L1 Spanish-L2 English children by Bohman et al. (2010), tested the semantic and morphosyntactic development of pre-nursery and nursery-aged children using the Bilingual English Spanish Oral Screener. Logistic regression modelling showed that the older age of participants was associated with higher scores on interpretation of morphosyntactic and semantic items. Measures included passives, negatives, and question inversion structures. However, as with Bedore et al., (2016), results for all structures were reported globally (i.e., a combined measure) so it is not known if a separate analysis of scores for specific complex measures may have produced a different outcome.

In a study by Paradis et al (2017), the use of relative clauses was examined alongside coordinate, complement, and adverbial clauses. The aim of the study was to investigate the production of these structures in child second language acquisition learners of English using comparable methods to that of existing first language acquisition studies (Diessel, 2004; Huttenlocher et al., 2010; Vasilyeva et al., 2008). The child second language learner data was collected using recordings from spontaneous speech and a narrative task (the Edmonton Narrative Norms Instrument, Schneider et al., 2005). They tested 187 child second language learners of English, with a mean age of 5;10, mean age of onset of 4;4, and mean second language length of exposure of 17 months, and with various first language backgrounds (Arabic, Cantonese, Hindi, Mandarin, Punjabi, Spanish, and Urdu). Neither age measures (age of onset and age at time of testing) predicted production of target sentence structures for the child second language learners. However, in contrasting the participants' use of the structures with what has been reported in other studies for first language learners (i.e., Diessel, 2004; Huttenlocher et al., 2010; Vasilyeva et al., 2008), the child second language learners were shown to produce a higher proportion of the target sentence structures (18%) versus what the literature describes first language learners as using (10%). In addition, as the first language children reported on in the previous literature were between 2;0 and 4;0 and thus the child second language participants older (mean age: 5;10), Paradis and colleagues use this to affirm that older age does in fact impact use of the target sentences (i.e., coordinate, complement, and adverbial, and relative clauses). In fact, this study found that even child second language learners with very limited exposure time (in some cases, a few months) produced the target structures. As with other studies showing an older age advantage, the researchers suggest that greater cognitive and linguistic maturity allows older learners to utilise these more complex structures earlier in second language development. Although significant effects were not found for measures of age within the child second language acquisition cohort, the authors acknowledge that the age ranges included (4;7 to 5;5) may have been too narrow to observe any differences.

In summary, chronological age appears to mostly predict lexical proficiency (e.g., Paradis, 2011; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978) while its impact is much more mixed for morphosyntax revealing positive effects (e.g., Paradis, 2011; Snow & Hoefnagel-Hohle, 1978) or no impact (Chondrogianni & Marinis, 2011) for morphology, and a positive effect (Armon-Lotem et al., 2011- for L1 Russian children acquiring L2 German; Bohman et al., 2010; Paradis et al., 2017;) or limited or no impact (Armon-Lotem et al., 2011- for L1 Russian children acquiring L2 Hebrew ; Chrondrogianni & Marinis, 2011) for syntactic measures. The following section will summarise this review on findings across age effects (for both age of L2 onset and chronological age) in sequential bilingual acquisition.

2.2.3 Summary of age effects in sequential bilingual acquisition

The review of previous research on age effects in sequential bilingual acquisition has shown that despite the predominant view that ‘younger is better’ in second language acquisition, in some cases, older children have an advantage in the development of L2 linguistic knowledge. This is most strongly shown in the lexical domain where both an older age of L2 onset (Blom & Bosma, 2016; Golberg et al., 2007; Snedeker, 2007; Unsworth, 2016a) and chronological age (Paradis, 2011; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978) mostly predict greater vocabulary proficiency which has been linked to the higher cognitive capacity and linguistic experience of older children. More specifically, more linguistic experience means they have access to a wider range of strategies for word learning. Age effects appear less robust in the morphosyntactic domain as findings were mixed across studies. In terms of age of onset, findings demonstrate both an older (e.g., Blom & Paradis, 2015; Paradis, 2011; Rothman et al., 2016; Snow & Hoefnagel-Hohle, 1978) and younger (Bedore et al., 2016; Jia and Fuse; 2007; Nishikawa, 2014; Roesch and Chondrogianni, 2016) advantage, or limited or no effects (e.g., Armon-Lotem et al., 2011; Blom & Bosma, 2016; Paradis & Blom, 2016; Paradis et al., 2017; Snedeker et al., 2007; Unsworth, 2016). Chronological age mostly predicts morphological development (Paradis, 2011; Snow & Hoefnagel-Hohle, 1978) and while some studies have found an advantage for older chronological age in relation to sentence structures (e.g., Bohman et al., 2010; Paradis et al., 2017) others have not found an effect (Chondrogianni & Marinis, 2011).

This review highlights the importance of methodological considerations in language research. This involves accounting for or controlling other influencing effects which may impact or confound results including language exposure and L1 background. In addition, if the focus of the study is performance on specific language measures, then domains may have to be analysed separately to observe particular effects. In addition, the complexity of tasks used to measure language may inadvertently advantage one age group over another if it places higher cognitive demands on the individual.

2.2.4 Working memory

Working memory involves the capacity to temporarily hold information from the environment in mind (e.g., short-term memory), and the retention, processing, or manipulation of that information (Baddeley & Logie 1999; Baddeley, 2003; Gathercole & Alloway, 2007). While the organisation of working memory systems in many primates is similar to the human system, our ability to preclude interference and utilise attention to manipulate information and use reflective thinking in working memory, is unique (Carruthers, 2013). Working memory is an important tool in the completion of mentally demanding tasks including mathematics, planning, problem-solving, and language processing. According to Baddeley's (2003) model, working memory comprises different components: a phonological loop which registers sounds and verbal information; the visuo-spatial sketchpad which allows visual and spatial (objects and locations) information to be temporarily stored and manipulated; and the central executive component which manages attention to information. The short-term memory component of working memory has been shown to play an important role in learning novel vocabulary (e.g., Avons, 1998; Cheung, 1996; Majerus et al., 2006; Masoura & Gathercole, 2005) as it permits the temporary storage of new phonological representations which is strongly associated with retention of representations in long-term memory (Baddeley et al., 1998). Short-term memory may also be important in the offline comprehension of sentence structures due to involvement in the ability to repeat an utterance in mind (Papagno et al., 2007). The purpose of the visuo-spatial sketchpad is to provide a temporary mental representation of information in visual or spatial form (e.g., objects and locations) which can be briefly stored and manipulated (Baddeley, 2003). This element along with the central executive component of working memory may be important in learning grammar due to its contribution to noticing and processing language structures (Mackey et al., 2002; Papagno et al., 2007).

Working memory is known to vary among the population in general, with one person having greater ability than another (Gathercole & Alloway, 2007). Additionally, working memory can become severely restricted through distraction, attempting to store too much information, or due to completing a challenging activity, thereby affecting storage and processing of information (Gathercole & Alloway, 2007; Just & Carpenter, 1992). This is important when considering parsing load in relation to more complex linguistic features and also the complexity of tasks. Complex language will be discussed further in the following chapter.

Tests of working memory evaluate the participant's capacity to store and process incoming information for a short period of time. Common measures of working memory include non-word repetition and digit span tasks. Non-word repetition tasks are commonly used as an evaluation of phonological short-term memory as they correspond similarly to the phonological component of word learning and because the use of non-words decreases any possibility of interference from previously stored lexical, morphological, or syntactic information (Coady & Evans, 2008; Gathercole & Baddeley, 1989; Gathercole & Martin, 1996). In a non-word repetition task, the individual listens to made-up words one by one, and repeats what they hear verbatim. The number of made-up words gradually increases in syllable length throughout the assessment which progressively increases the difficulty. Digit span tasks can be used to test both short-term memory via the forward digit span task or working memory via the backward digit span task. In digit span tasks, the participant is verbally presented with a string of numbers by the interlocutor which they then have to repeat back either in the same sequence (forward span) or the opposite sequence (backward span) (Atkins & Baddeley, 1998). The string of numbers increases in length throughout the task.

Research carried out in first language acquisition demonstrates that those with higher working memory capacity have advantages in sentence processing in comparison to those with lower working memory ability (Chen et al., 2008; Just and Carpenter, 1992; Kim and Christianson, 2007; MacDonald et al., 1992; Swets et al., 2008). Working memory capacity has also been shown to be a significant predictor of bilingual and L2 children's second language proficiency (e.g., De Cat, 2020; Hart & Harley, 1997; Gathercole, 2006; Masoura & Gathercole, 1999; Paradis, 2011; Paradis et al., 2016; Paradis et al., 2017; Verhagen et al., 2015; Verhagen & Leseman, 2016). In terms of short-term memory, Thorn and Gathercole (1999) showed that French-English bilingual children's (aged 4-8) receptive lexical development was positively impacted by this factor measured using digit span and non-word repetition tasks. Paradis (2011) demonstrated similar results for children acquiring English as a second language with short-term memory (measured using the digit span and non-word repetition) found to be the most robust predictor of both receptive lexical skills and use of morphology. Short-term memory also predicted longitudinal (3 years) use of morphology by Cantonese and Mandarin L1 speaking children (mean age=8;5 at 1st round) acquiring L2 English with this factor specifically predicting regular and irregular past tense, and BE and DO auxiliaries (Paradis et al., 2016). In terms of sentence structures, a study by Paradis et al. (2017) demonstrated that short-term memory capacity (tested using non-word repetition) predicted use of multiple-clause sentence structures (relative, coordinated, complement, adverbial clauses) evaluated through the use of spontaneous speech and a narrative task. Some previous studies have included independent measures of short-term memory and working memory as predictors of L2 children's vocabulary and syntax. Verhagen and Leseman (2016) investigated short-term memory and working memory (evaluated by using a word recall task and a backward digit recall task, respectively) on the receptive lexical development and subject-verb inversion (evaluated through the completion of a sentence repetition task) by Turkish-L1 speaking children acquiring L2 Dutch (mean age=63 months). Results demonstrated that while short-term memory predicted vocabulary skills, both short-term memory and working memory predicted the children's acquisition of subject-verb inversion. Results by Engel de Abreu et al. (2011) also showed that short-term memory, independently of working memory, predicted lexical development. However, measures of cognitive control (goal or context representation and maintenance, and strategic processes such as attention allocation and stimulus-response mapping) predicted receptive syntax (as measured using the TROG) in Luxembourgish-German bilingual children (aged between 5-6 years old). Recent research by De Cat (2020) has shown that while both short-term and working memory (evaluated using a digit span task) predicted lexical semantics, short-term memory but not working memory, predicted use of passives, object wh-questions, and object relative clauses (measured using sentence repetition) by 87 bilingual children (aged 5-7) from various L1 backgrounds.

In summary, short-term memory (the ability to temporarily hold information from the environment in mind) and working memory (the retention, processing, or manipulation of that information) are important factors in children's bilingual or second language development. While the short-term memory component of working memory has been shown to predict vocabulary (e.g., De Cat, 2020; Engel de Abreu et al., 2011; Paradis, 2011; Thorn & Gathercole, 1999; Verhagen & Leseman, 2016) and morphology (Paradis, 2011; Paradis et al., 2016), results for syntactic structures are more mixed. Some studies show positive effects for the impact of both short-term and working memory (e.g., Engel de Abreu et al., 2011; Verhagen & Leseman, 2016), while others have found only short-term memory to predict complex structures but not working memory (e.g., De Cat, 2020).

2.2.5 Motivation

Motivation is considered a significant cause of individual variation in outcomes of second language proficiency (Ushioda & Dörnyei, 2012). While definitions of motivation vary, a broad view is that it governs an individual's choice of action, their perseverance with the activity, and the amount of exertion applied in doing the action (Dörnyei, 1994). Motivation in second language acquisition is considered to be somewhat different from motivation in other domains as it not only entails acquiring linguistic knowledge but may involve the individual identifying with the target language culture and community (Gardner & Lambert, 1972; Herschensohn, 2007) and can therefore involve individual attitudes towards the second language. According to Dörnyei (1994, p.290) motivation in second language acquisition involves three levels:

> "the language level (integrative and instrumental motivational subsystems), the learner level (individual motivational characteristics), and the learning situation level (situation-specific motives relating to the course and social learning environment)".

Most research investigating motivation has focused on adult students learning a second language in a classroom setting with motivation shown to be linked to greater language learning outcomes (e.g., Gardner, 1985; Masgoret & Gardner, 2003). In a study by Engin (2009) the impact of different types of motivation was investigated which included: (1) general motivation referring to the learner's feelings towards the target language; (2) integrative motivation, referred to as the personal motivation and desire to know the target language's native speakers; (3) instrumental motivation, discussed as that which is linked with a pragmatic purpose for learning the target language whereby learners study harder to achieve higher grades; (4) and work avoidance motivation, which is the avoidance of studying hard. Participants were 44 native Turkish speakers aged between 17 and 21 years old. Learners were given a language proficiency test and asked to complete a questionnaire which comprised specific questions covering the different motivational levels. Results showed that integrative and instrumental motivation contributed to positive outcomes in learning English in a foreign language context. Therefore, results indicate that motivation to engage with native speakers of the L2 and motivation for achieving high marks were associated with greater L2 language outcomes.

In terms of younger students learning an L2 in a classroom setting, Nikolov (1999) found that children are typically highly motivated in the initial stages but that this dissipates over time as the learner gets older. In a study by Wei (2016) young Chinese students aged between 7 and 12 years old who were learning English as a second language in a classroom setting were observed and interviewed along with their class teacher. Results revealed that a reduced motivation for learning the L2 was associated with a lack of awareness of the value of the L2, reduced interaction between students and teachers, and poorly designed teaching materials. While the previous studies focused on classroom based L2 learning some studies have investigated motivation and specifically, integrative motivation, in relation to language immersion contexts. According to Shirbagi (2010), integrative motivation may be more important in terms of language learning outcomes as the impetus for the individual in this scenario is to integrate with the target language culture, and that this might have greater appeal than learning the language for educational or work purposes. Integrative motivation has been shown to interact with age for young learners in immersive settings. Minoura (1992) found that children who immigrated to Japan at younger ages appeared more motivated to integrate with cultural aspects of the second language and therefore assimilated to the new culture and linguistic situation more quickly and to a greater degree than those who immigrated at older ages. Jia and Aaronson (2003) found a similar pattern in that younger Chinese immigrants to the US demonstrated a preference or motivation towards integrating into American culture while the older children favoured their native Chinese culture. This study will be explored further in Section 2.3 on input effects in child second language acquisition.

In summary, motivation has been shown to be an important factor in adult L2 acquisition, but this has been argued in studies involving classroom based settings. Research on immersive settings suggests that integrative motivation may interact with age in that younger learners appear to be more motivated to integrate with the new culture and that this may have a positive outcome on L2 language acquisition. The following section will consider the external factors which influence language acquisition.

2.3 External factors

External factors in language acquisition comprise the environmental contexts of language exposure and in previous research on second language acquisition have included amount of language input, language use or output, the qualitative richness of the language environment, socio-economic status, and parental second language proficiency (e.g., De Houwer, 2018; Paradis, 2011; Unsworth et al, 2011). Quantitative language factors can refer to the amount of exposure a language user experiences in contact with the target language and is often determined by measuring the overall length of exposure or the amount of target language contact at home, school, and in the community (Paradis, 2011; Unsworth et al, 2011). More fine-grained measures of L2 exposure can involve measuring the amount of L2 input/output across the different L2 settings the individual participates in. The quality of language input typically refers to the richness of the target language which can include the activities the individual engages in with the target language as the primary language in these settings. This includes reading, watching TV, and play or social activities (Paradis, 2011). In addition, environmental factors have been categorised under the terms proximal and distal. Proximal factors refer to those which directly impact the individual's language exposure on a regular basis (e.g., input from family members, teachers and peers). Distal factors include those which impact the situational context in which input is provided (e.g., parental language proficiency, family size, and socioeconomic status such as parental educational level or occupation) which in turn influences the individual's language exposure (Hoff, 2006; Paradis & Grüter, 2014; Sorenson Duncan, 2017).

Variability in the linguistic proficiency of bilinguals is often attributed to the differences in individual linguistic experiences (Gathercole, 2014; Unsworth, 2016b). This appears most evident when comparing lexical proficiency between bilingual and monolingual children in the early stages of linguistic development. Bilinguals are typically shown to underperform in each of their languages compared to monolinguals, a disparity attributed to the shared distribution of linguistic exposure between the two languages (Golberg et al, 2008; Hoff & Naigles, 2002; Kan & Kohnert, 2005; Unsworth, 2016b). However, see De Houwer (2014) whose findings on the amount of input experienced in language acquisition challenges the assumption that bilinguals are exposed to less target language input compared to monolinguals. While input has been shown to impact the lexical domain for bilinguals (e.g., Chondrogianni & Marinis, 2011; Paradis, 2011; Pearson et al., 1997; Thordardottir, 2011) its effect in the morphosyntactic domain is less definitive. Previous research on input effects has investigated various properties in the domain of morphosyntax which has included tense morphology (Blom, 2010; Blom et al., 2012; Chondrogianni & Marinis, 2011; Jia & Aaronson, 2003; Jia & Fuse, 2007; Paradis, 2011), that-trace effect (Gathercole, 2002a), wh- questions, (Armon-Lotem et al., 2011; Chondrogianni & Marinis, 2011; De Cat, 2020), passive voice (Armon et al., 2011; Chondrogianni & Marinis, 2011; Rothman et al., 2016; De Cat, 2020), and embedded clauses (Armon et al., 2011; De Cat, 2020; Paradis & Kirova, 2014; Paradis et al., 2017; Sorenson Duncan, 2017). While findings from previous research have been mixed, it should be noted that different methods in measuring language exposure have been employed in studies as well as different types of tasks in evaluating the target language features. This section will start by examining the impact of the quantity of language exposure in bilingual acquisition.

2.3.1 Quantity of language exposure

Quantity of language exposure is commonly evaluated by measuring the individual's length of exposure to the target language. Length of exposure refers to the amount of time the individual has been exposed to the target language and is traditionally measured in years or months by subtracting the individual's age of onset to the target language from their chronological age (Roesch & Chondrogianni, 2016; Unsworth, 2016a). In the case of second language research, study participants who are immigrants have often had length of exposure calculated from their age of arrival to the second language-speaking country (e.g., Johnson & Newport, 1989, 1991). However, in sequential bilingual acquisition in childhood the first language may be the only language the individual is significantly exposed to for a protracted period of time after immigration has occurred and therefore exposure to the sequential (or second) language may be extremely restricted within this phase. In light of this, a measure of length of exposure is often made from the time the individual begins significant and consistent exposure (also referred to as meaningful exposure) to the sequential language, which for children, often occurs on commencing nursery or primary school (Paradis, n.d., 2011). A number of studies have found that length of exposure predicts proficiency of morphology (e.g., Armon-Lotem et al., 2011; Blom et al., 2012; Chondrogianni & Marinis, 2011; Paradis, 2011) and sentence structures (e.g., Paradis et al., 2017). However, one of the difficulties with employing this type of measurement is that length of exposure and age of onset are linearly dependent (Stevens, 2006) and as studies often include a measure of both this can create a confound which may only allow a weak account of input effects (Paradis, 2011; Unsworth et al., 2014). One alternative is to measure input by comparing the different linguistic environments or settings the subjects participate in. The following paragraphs will review research which has comprised differences in language environments as a measure of input.

Measuring input in terms of differences in language environments can involve comparing language input at home (normally first language only) versus day-care (where the language of instruction is the sequential/second language), or between a first language only home environment and a first language or second language home environment, or the different number of days per week the child attends a second language speaking day-care facility (e.g., 3 days a week versus 5 days a week). In a longitudinal study by Blom (2010) 4 L1 Turkish–L2 Dutch bilingual participants aged between 2;0 and 3;06 were selected on the basis of their different L1/L2 input settings: one participant attends Turkish–Dutch day-care 5 days a week (high Dutch input); one attends Turkish–Dutch day-care 3–5 days a week, and another brought up at home until age 3,4 with parents who are highly proficient Dutch speakers (both representing moderate Dutch input); and one is brought up in a Turkish-dominant home (low Dutch input). The study examined the acquisition of finite morphology by the bilinguals who were examined alongside similarly aged monolingual Dutch children. Using recordings of spontaneous speech, the researcher observed that the bilingual children's use of finite verb type in their weaker L2 Dutch at age 3 reflected that of the 2-year-old Dutch monolingual children. Results also showed that the monolingual Dutch children had higher scores across measures (lexical, mean length of utterance, and finiteness) compared to all the bilinguals. There were no differences between the bilingual children in relation to their Dutch lexical development. In relation to grammar and syntax, results showed that the bilingual with the most Dutch input had better scores for mean length of utterance and finiteness. The bilingual brought up at home with a highly proficient Dutch speaking mother had the next best scores while the bilingual child with reduced Dutch input at day care and the child with little Dutch input at home had the poorer scores. Therefore, results suggest that differences in L2 input environments impact morphosyntactic features. More regular L2 input at day care or L2 input from highly proficient L2 users at home positively impacts morphosyntactic development of the L2.

In a series of studies conducted by Gathercole (2002a, 2002b, 2002c) in Miami, input was measured as per the type of language used at home and in school. The participants were monolingual English and Spanish speakers and Spanish-English bilinguals in the second and fifth grades of school. The Spanish-English bilinguals comprised two groups: a two-way method group, and an immersion English group. The two-way method is an educational approach which attempts to foster learning in the L1 while encouraging acquisition of an L2 with the language of instruction split between each language. Immersion education on the other hand sees the language of instruction mostly based on the L2. Therefore, the cohorts differed in the amount of exposure they had had in each language. For example, for length of exposure to English, monolinguals had the most, followed by fifth graders in the immersion setting, fifth graders in the two-way method, and second graders in the immersion setting, while second graders in the two-way setting received the least length of English exposure. In Gathercole (2002a) the effect of input was investigated in relation to the acquisition of a complex structure (in this case, the that-trace construction). That-trace effects involve the extraction of subjects out of embedded clauses. However, English and Spanish differ in that the English form cannot take an overt complementiser (1) while in Spanish this is obligatory (2).

(1) Who do you think ___ has green eyes?

(2)	¿Quién	piensas	que ___	tiene	ojos verdes?
	Who	you think	that	has	eyes green?

Proficiency in that-trace structures was tested using a grammaticality judgement task in which the participants were asked to assess the grammatical accuracy of eight sentences half of which were grammatical and half ungrammatical (four sentences in each language included the overt complementiser and four did not). On assessing a sentence as ungrammatical participants were asked to correct the sentence by saying how the sentence ought to be structured. Results for English showed that the monolingual participants outperformed the bilinguals while fifth graders did better than second graders (4.84 vs 4.13, out of 8). Furthermore, children with more English spoken at home performed better than those with only Spanish spoken at home. Results suggest that proficiency for that-trace sentences were related to the quantity of input the participants had received. Length of exposure effects were also found by Gathercole in relation to the same cohort but with two other linguistic properties: the mass-count distinction (Gathercole, 2002b) where the age-matched monolinguals outperformed bilinguals, and bilinguals in the immersion setting performed better than those in the two-way programme; and for grammatical gender (Gathercole, 2002c) where the Spanish dominant bilingual group outperformed the other bilingual categories.

However, some have called into question the differences found in timing between monolinguals and bilinguals in the Gathercole studies and its correlation with input effects (Cummins, 2004; Hoff, 2003; Oller & Eilers, 2002). For example, the English input available to children in the Miami context is associated with its large immigrant population which consists mostly of non-fluent speakers of English, and which may involve a moderated type of English language input meaning that their English exposure diverged greatly from the monolinguals' English input. To address this, Gathercole (2007) investigated the Welsh linguistic context which has a high presence of fluent bilingual (Welsh-English) speakers. Input was measured by categorising the participants into three groups according to the languages they spoke at home (Welsh only, Welsh and English, and English only), and the type of language instruction they received at school (Welsh only, or Welsh and English). The target linguistic properties were four types of gender marking in Welsh which ranged in complexity.[6] To test proficiency of grammatical gender, the study's

[6] Gathercole investigated the following gender marking in Welsh:

(1) masculine marking of noun phrases in which nouns and adjectives undergo no mutation;

(2) feminine marking of the noun phrase in 'local' syntactic contexts, in which singular nouns and adjectives with mutable sounds undergo a soft morpho-phonological mutation after the definite article;

(3) masculine gender marking the possessive to antecedent nouns in 'distant' syntactic contexts which also undergo soft mutation;

(4) feminine marking of the possessive to antecedent nouns in 'distant' syntactic contexts which undergo an aspirate mutation.

participants were given elicitation and receptive tasks. In the elicitation task they expressed local and distant gender forms. In the receptive picture selection task they chose between feminine or masculine referents following a sentence containing either soft mutation indicating masculine possessive marking through a masculine antecedent noun, or aspirate mutation indicating a feminine antecedent noun. Results showed that nearly all participants produced the masculine forms of nouns and adjectives (non-mutated, basic forms) at ceiling. The possessive masculine form appeared to be more difficult for all participants with those from Welsh-only speaking homes acquiring this at an earlier stage (age 5) compared to those from Welsh-English speaking homes (age 7) and those from English-only speaking homes (age 9). Production of feminine mutated forms of nouns and adjectives showed much more variation with the children from Welsh-only speaking homes outperforming those from Welsh-English and English-only speaking homes. In relation to input, results showed that for every structure, proportionally more exposure to the target language at home and in school facilitated greater performance at an early age compared to those with proportionally less target language exposure. Gathercole proposes that differences between groups in relation to input (length and type) in the early stages diminish over time, indicating that once the appropriate amount of input has reached its threshold for generalisations on structure to be appropriately derived, then length of exposure in the later stages is less significant. In addition, the results suggest that the threshold for grammatical forms which have more transparent one-to-one mapping of form and function happens much sooner and are therefore acquired earlier, while more opaque complex forms take a much longer time to reach threshold and are therefore acquired later.

According to Gathercole (2002a), findings from her studies give credence to theories which assert a usage/constructivist-based account of language acquisition, whereby if complex structures are infrequent in the input, little evidence for these is obtained and thus acquisition is delayed. One example is the correlation found in some studies between higher frequency and greater proficiency of the passive voice structure (in languages which have more passive constructions and are therefore

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Gathercole notes that while masculine gender of the noun phrase is opaque, gender marking of the feminine noun phrase and of the possessive provides no transparent one-to-one mapping between form and function, therefore it can be considered highly complex in acquisitional terms.

more frequent in the input, the children show earlier acquisition, e.g., Allen & Crago, 1996; Demuth, 1989; Demuth, 1990; Demuth et al., 2010). In contrast to the usage-based account for language acquisition, the longitudinal study by Rothman et al. (2016) detailed in the previous section on age effects (which examined comprehension of active and passive voice constructions), found that input could not account for the disparity in performance between two L1 Spanish-L2 English groups of children. The two groups differed in their age of L2 onset (early starters: 3;0–4;0; later starters: 6;0-7;0) but amount of input and the L2 exposure environment were comparable across groups in that participants had a similar length of L2 exposure and type of educational experience (all were English second language learners). As stated in the previous section, findings showed that the older group performed significantly better on comprehension of the passive structure than the younger group. Importantly, despite input type and length being very similar, the younger group took a much longer time to achieve ceiling scores compared to the older participants (five years instead of four). Therefore, Rothman et al. (2016) conclude that input cannot account for the disparity in performance between the two age groups. The authors propose that some grammatical phenomena require a longer duration of acquisition at particular ages due to the fact that language acquisition is partially constrained by general cognitive and linguistic development. However, as the authors acknowledge, there may have been aspects of the participants' L2 exposure that created differences in the quantity and quality of input between participants such as different teachers and experiences with others which were not documented. While measuring input in relation to second language environments allows a broad overview of L2 input, there can be much variation in the amount and characteristics of regular L2 exposure between bilinguals (Unsworth, 2013). To address this, fine-grained measurements of input which include documenting both quantity and quality of exposure are often used to capture a more comprehensive view of second language input for each bilingual individual so that a truer representation of input can be attained. The following section will review types of language input which aim to capture more fine-grained measures in relation to the quantity and quality of language exposure in sequential bilingualism.

2.3.2 Fine-grained measures of language input

Fine-grained measures of the second language environment can involve measuring the child's regular exposure and use of the L2 in a number of settings, the L2 activities they participate in, and how this manifests over time. Fine-grained measures of the language environment are often measured by way of parent questionnaires (e.g., De Cat, 2020; Jia & Aaronson, 2003; Jia & Fuse, 2007; Paradis, 2011; Unsworth, 2013). To calculate fine-grained measures of language quantity and quality Paradis (2011) used the Alberta Language Environment Questionnaire (ALEQ; Paradis, n.d.). Examples of fine-grained input measures from the ALEQ include calculating the child's language use at home and richness of the L2 environment. Language use at home refers to how much of the target language is heard by the individual (how much the other household members use the target language to the child) and how much is produced by the individual (how much the child uses the target language at home to other household members, e.g., parents/caregivers, siblings, and other adults). It is conceivable that language input and output may impact on the individual's language skills differently. This type of data collection tool differs from the attempt to calculate language input in that it considers opportunities for the individual to practice and use the language rather than just passively receiving it which may likely facilitate greater development of language especially in terms of expressive skills (e.g., Bohman et al., 2010; Hammer et al., 2012). For evaluating this measure, parents are asked to rate the use of the target language(s) by choosing a score from a 5-point rating scale:

0 = Mother tongue always/English never,

1 = Mother tongue usually/English seldom,

2 = Mother tongue 50%/English 50%,

3 = Mother tongue seldom/English usually,

4 = Mother tongue almost never/English almost always.

However, Paradis et al. (2017) and Paradis and Kirova (2014), both of which investigated the same sentence structures (coordinate, complement, relative and adverbial clauses), showed that the use of target sentences was not predicted by L2 language use at home. The authors suggest that these findings could indicate that non-native speakers who have a decreased fluency in the second language in the home may have a negligible impact on the child's second language ability, a finding which has been replicated in other research (e.g. Hoff et al., 2014). In a study by Chondrogianni and Marinis (2011), quantitative and qualitative measures of input were also evaluated through parental questionnaires documenting the language environment using a similar format to the ALEQ questionnaire whereby a more fine-grained measure of input was calculated. As described in the previous section on age effects, this study measured receptive lexical knowledge, expressive morphological inflection (third person singular and past tense morphemes), and the comprehension of complex sentences (wh-questions, and passive voice). Results showed that use of English in the home was only correlated with proficiency of the past tense morpheme and wh-questions. However, once the measure was entered into a logistic regression analysis it was not found to predict any measure.

Unsworth (2013) also used a parent questionnaire (The bilingual language experience calculator; BiLEC) to allow fine-grained measures of input, namely current length of exposure and cumulative length of exposure, to be measured. To measure participants' current amount of input, Unsworth asked parents to indicate the amount of L1/L2 speaking time the child experienced from adults on an average day during the week and at the weekend and the amount of time spent at day-care or school and at extra-curricular activities and what language was used at each. From this, a calculation of the amount of time spent receiving linguistic exposure was multiplied by the amount this time was spent in the L2. This provided a total amount of hours of L2 exposure which was then divided by the total number of waking hours to give an overall percentage of current weekly L2 exposure. The cumulative measure comprised measuring L2 exposure from the child's birth to time of testing. This involved measuring how much each adult living at home spoke in the first or second language for each one-year period of the child's life and whether the child attended day-care or school and what the language of instruction was. From this, the proportion of each one-year period in the L2 was calculated to provide a total amount of L2 exposure in years over time. Unsworth (2013) illustrates the difference between traditional and cumulative second language length of exposure measurements by showing that bilingual participants in her study had a mean length of exposure of 10.4 years compared to just 5.6 years of cumulative exposure. Furthermore, she noted that when the monolingual controls in the study were matched with bilingual cumulative length of exposures, differences in proficiency of target structures (definite determiners in Dutch) disappeared, with results showing no significant effect between groups.

De Cat (2020) also measured cumulative exposure using a parent questionnaire adapted from the BiLEC questionnaire by Unsworth (2013). As with the previous parent questionnaires, it comprised a number of questions regarding the parents' and children's language backgrounds including how often they spoke in the home language and the L2 with people at home and the activities they engaged in, in both the home language and the L2. Furthermore, parents also provided information on how often the child interacted in either the home or L2 language during different periods of the day (7am-bedtime) during both the week and at weekends. This aimed to capture language use for all the child's waking hours thereby providing a more comprehensive picture of the participants' L2 exposure. This study investigated a number of syntactic structures ranging in complexity (declarative sentences with one auxiliary, short passives, object wh-questions with what/who, long passives, object wh-questions with which, temporal and conditional clauses, and object relative clauses) using sentence repetition, sentence comprehension, lexical semantics and discourse semantics. Participants were children aged between 5-7 years old from various L1 backgrounds acquiring English as a second language. Alongside cumulative input, several individual difference factors were measured as predictor variables including short-term and working memory, chronological age, and socio-economic status. Linear regression analyses revealed that of all the individual difference factors included, the measure of cumulative input was the most robust predictor of the children's L2 English for production of sentences and a significant predictor of lexical semantics. Similarly, a study by Roesch and Chondrogianni (2016) which included a cumulative measure of input as a predictor variable on proficiency of subject and object German 'which' questions (wh-questions) found that cumulative input was the most important of all factors included in the study in predicting comprehension of these structures.

In addition, it is proposed that input effects in bilingual language acquisition may be more important for language features which are late acquired in L1 acquisition as per Tsimpli's (2014) suggestion that early acquired grammar is affected more by age of onset effects while late acquired grammar is affected more by input. Tsimpli proposes that as early acquired features (e.g., head directionality) are set in the early stages of L1 acquisition (around 3 years old) then these features will be impacted more by the age the bilingual begins acquiring the target language. In contrast, language features which are acquired later would be less affected by age of onset and more responsive to input effects. In the preceding paragraph both studies (Roesch & Chondrogianni, 2016; De Cat, 2020) involve language structures which are late acquired (wh-questions are late acquired in German; and passives and object relative clauses are late acquired in English) which support this theory. Indeed, findings from other studies which have included early and late acquired structures also appear to support this theory as input as opposed to age of onset impacted the late acquired language features (e.g., Ågren et al., 2014; Unsworth et al., 2014). The present study will include target language features which are both complex and non-complex. Complex language features are often acquired late while less complex language features are often acquired earlier. In light of this, it could be expected that the more complex language features which will be included in the present study will also be more affected by input while the less complex features will be impacted more by age of onset effects. This will be explored further in light of the results.

Another fine-grained measure of language input is richness of the second language environment. Richness of the second language environment comprises the second language activities the child engages in with the second language as the primary language of use which includes reading, watching TV, play with friends, and social or extracurricular activities. Paradis (2011) and Paradis et al. (2017) found that richness of the second language environment significantly impacted proficiency of morphological tense marking and complex sentence structures, respectively. The reason for the strong impact of this factor on language proficiency may be due to language exposure through play or play-based settings (Folli et al., 2015; Kane et al., 2017). Acquiring language through play with peers is beneficial in comparison to learning language through formal settings. Firstly, it often involves symbolic thinking where children engage in pretend play behaviour (e.g., dressing-up, role-playing, and object substitution-the non-literal use of objects, actions or persons) which is associated with greater visual object recognition and furthermore, the development of noun vocabulary skills (Pereira & Smith, 2009; Smith, 2003; Smith

& Jones, 2011). The social-interaction element of play often involves collaboration between children where they assume different roles and negotiate the direction of play which may comprise the use of more advanced language skills including complex grammatical and pragmatic forms compared to what is used in other situations (Bergen & Mauer, 2000; Weisberg et al., 2013). Also, a play activity offers children the opportunity to engage with a considerable amount of language input and use. In relation to L2 language development, interaction through play has been shown to motivate preschool children to engage with the L2 and practice their L2 skills in supportive and encouraging environments (Fassler, 1998; Piker, 2013). Playing with others provides children with the opportunity to learn language from peers and to practice what they may have previously acquired in other situations. Ervin-Tripp (1991) found that interactions with peers, some of whom were native speakers of the L2, extended the knowledge of child L2 learners' use of vocabulary and syntax. This occurred through different interactional processes including imitation of language (i.e., copying the language used by a peer), inferring meaning from context, receiving corrections of language used, copying predictable language sequences, and rearranging and combining language previously heard or used in other situations. In addition, using language with peers likely provides L2 children with opportunities to use and practice the L2 informally. This may be less likely to cause anxiety compared to interactions in more formal settings such as the classroom where interactions with a teacher can typically involve a more public demonstration of language knowledge (Johnson, 1994).

Research by Jia and Fuse (2007) also used a parent questionnaire which included qualitative measures of L2 exposure comprising play-based activities. This involved measuring the number of hours watching TV, the number of books read in the target language, and the number of friends who mainly spoke in each of their two languages. These factors were combined with the participant's amount of time speaking the L2 at home to obtain a composite environmental score. As stated in the previous section on age effects, this longitudinal study investigated production of target morphological structures (third person singular, copula BE, regular and irregular past forms, progressive aspect, and Do) by Mandarin-speaking children acquiring English as a second language through the use of spontaneous speech samples. Findings indicated that the language environment measure was a stronger predictor of performance variance in morphological proficiency than age of onset.

In addition, and as found in a similar study by Jia and Aaronson (2003) which used the same participant cohort, there was an interaction between input and age with early arrivals switching their preference or dominance for the second language sooner than the later arrivals therefore allowing a richer environmental second language experience. The issue of language dominance appears to be an important factor regarding input effects in sequential bilingual language acquisition. Commonly, input of acquired languages in sequential bilingualism is divided between the first language at home and second language at school and this shared distribution results in an unbalanced linguistic proficiency with the first language typically the stronger language (Grosjean, 2010). However, sequential bilingual children show a sharp increase in second language development during their first few years of schooling (Rojas & Iglesias, 2013; Uccelli & Paez, 2007) while the first language, although maintaining an upward developmental trajectory, may slow significantly (Pham & Ebert, 2016). A significant rise in second language exposure through increased interaction with second language-speaking environments both inside and outside of the school setting is often driven by a desire to interact and fit-in with the majority community as well as an awareness of the higher social status of the second language (Montrul, 2008). This development can result in a shift in preference and dominance from the first language (or one of the first languages) to the majority language and if the dominance is maintained, attrition of the weaker language's linguistic system can occur (Montrul, 2008). This is a situation commonly attributed to the heritage language learner population whereby children who are simultaneous or sequential bilinguals in childhood switch their preference to the majority language of the country resulting in severe attrition of the other language (Valdés, 2000). In Jia and Aaronson's (2003) study they found that age influences when language preference switches from first language to second language with younger second language starters switching preference sooner than older second language starters. This was shown to significantly impact the quantity and quality of second language exposure received by the younger starters who acquired increased exposure to richer second language activities (e.g., reading and listening activities).

Differences in findings between measures of input demonstrates the importance of including more comprehensive and specific measures of input which allow a deeper understanding of which types of language exposure are important in language acquisition for the sequential bilingual population. The following section will review research on distal input factors (socioeconomic status and parental second language proficiency) in sequential bilingual acquisition.

2.3.3 Distal input factors

As mentioned in the introductory section, input can be impacted by both proximal (direct and regular contact) and distal (indirect contextual) factors within the individual's social sphere. Distal factors are those which influence the context in which direct proximal input is provided (Hoff, 2006; Sorenson Duncan, 2017) which can include factors such as socioeconomic status and parental second language proficiency. The following sections will briefly review each of these factors.

2.3.3.1 Socio-economic status

Socio-economic status denotes an individual's social class or standing and is often determined by occupation, household income, and educational level (Gathercole et al., 2016). Socio-economic status is associated with a number of outcomes across an individual's lifetime including physical and psychological health (Ayoub et al., 2018). This factor has also been shown to predict the amount of language input a child receives at home and thus has considerable implications for an individual's linguistic development (e.g., Hart and Risley, 1995). Socio-economic status has been measured in a number of ways in language acquisition research including parental income, parental occupation, the child's school type (private versus public), and parental education. A seminal study by Hart and Risley (1995) investigated the effect of socio-economic status on monolingual children's language development. Children whose parents were in receipt of welfare were categorised as being from a lower socio-economic background while children whose parents had professional occupations were categorised as being from a higher social economic background. Findings showed that the vocabulary development of children from lower socio-economic backgrounds demonstrated severely protracted vocabulary proficiency compared to children who were from higher socio-economic settings. This was related to differences in the language input the children received from their parents. It was revealed that mothers and fathers who were in receipt of welfare used less than one third of the amount of words (62,000 compared to 215,000) per week with their children compared to parents who had professional occupations. Previous research has also found that cross-culturally, the child-directed speech of mothers from higher compared to lower socio-economic backgrounds contained more diverse vocabulary, comprised more complex syntactic sentences, and was more frequently used for eliciting conversation (e.g., Hoff et al., 2002; Huttenlocher et al., 2002; Hoff, 2003; Vasilyeva et al., 2008). The impact of socio-economic status in relation to bilingualism and child L2 acquisition has been somewhat mixed with some studies finding positive effects in relation to vocabulary (e.g., Oller & Eilers, 2002; Golberg et al., 2008), morphology (Blom et al., 2010), and syntax (Bohman et al., 2010; De Cat, 2020); while others have found no impact in relation to morphology (e.g., Paradis, 2011) and syntax (Paradis et al., 2017).

In relation to sequential bilingual acquisition, the impact of socio-economic status was demonstrated in a study by Oller & Eiler (2002). This study used parental occupation to measure socio-economic status and investigate its impact on the language and literacy of child second language learners through a series of measures. Socio-economic status predicted each language measure with the strongest impact demonstrated on vocabulary. The study noted that parents of children with lower socio-economic status encouraged second language learning viewing it as a way to achieve academically. Despite this, second language learning was not well supported at home resulting in decreased language outcomes for this group. In contrast, professional parents of participants appeared to value the first language more than parents from lower socio-economic status backgrounds. Nevertheless, they gave more assistance with the second language at home which appeared to be related to their higher second language proficiency compared to participants from working class backgrounds. However, research which has included different measures of socio-economic status, as well as testing across a number of linguistic tasks and L1 and L2 combinations, has found that different types of measures may result in different predictions.

In a study by Armon-Lotem et al. (2011) the impact of socio-economic status was measured by correlating the parent occupations (both the father's and mother's) and the mother's educational level with a number of language measures (prepositions, inflections, complex syntax, case, and vocabulary). Socio-economic status, measured by way of the mother's education, was shown to be a strong predictor of all first language factors (prepositions, imitation inflections, complex syntax, case, sentence completion inflections, and vocabulary) in the Russian-German bilingual group, with the mother's and father's occupation also revealing a significant effect on some language measures (prepositions, sentence completion inflections, and case). However, the picture is somewhat different for second language proficiency of this same linguistic group (first language Russian-second language German), where it was found that the father's occupation strongly predicted all linguistic measures, the mother's occupation and the mother's educational level had a weaker correlation, with a significant correlation found for only the standardised test and prepositions respectively. Measures of complex syntax for second language German (wh-questions, passives and relative clauses) were included in a standardised test and were predicted by the father's and mother's occupation, while the mother's education did not reveal a significant impact for this linguistic factor. This highlights the importance of including more than one measure of socio-economic status.

Previous research (Sorenson Duncan, 2017) has also shown that the impact of maternal education may represent a more complex picture in which its impact depends on whether the mother received her education in the L1 or L2. Sorenson Duncan's (2017) study found that maternal education completed in the L2 impacted positively on the children's productive use of complex L2 sentences. However, the study also found that the impact of maternal education demonstrates a more complex picture in which its effect on acquisition on sentence structures can depend on whether the mother's education was completed in the first or second language. The findings indicating that second language children's production of complex sentences is positively influenced by mothers educated in the second language.

Another finding in relation to socio-economic status is that it may also interact with the child's amount of L2 exposure. De Cat (2020) found that the advantages of a higher socio-economic context on children's L2 proficiency only manifested when children were exposed to higher levels of L2 input. Socio-economic status was measured by way of the parents' level of education and their current occupation with the highest level of education or occupation selected (either the mother's or father's) in each case. Socio-economic status was found to predict the children's production of sentence structures (declarative sentences with one auxiliary, short passives, object wh-questions with what/who, long passives, object wh-questions with which, temporal and conditional clauses, and object relative clauses) and lexical semantics. Furthermore, socio-economic status interacted with language exposure in that participants with lower levels of L2 input were not as affected by socio-economic status as those with higher levels of L2 exposure.

2.3.3.2 Parental L2 proficiency

In comparison to other extraneous factors normally measured in second language acquisition, fewer studies have included parental second language proficiency as a measure impacting language development. In relation to immigrant or refugee populations, parental second language proficiency may vary considerably as some parents may be in the early stages of acquiring the second language while others who emigrate for employment or study opportunities may have quite high levels of fluency. It seems intuitive that the better a parent's proficiency in the second language the more successful they will be in expressing and demonstrating the second language to their child and therefore the more impact it will have on children's own L2 proficiency levels (Sorenson Duncan & Paradis, 2018). Gathercole and Thomas (2005) found that parents' proficiency in Welsh impacted whether they used Welsh with their children at home. Therefore, parents of sequential bilinguals may only engage with their children in the L2 if they have high enough proficiency in the L2. Findings have been somewhat mixed for the impact of this measure on L2 proficiency and depend on the domain under investigation. Both Chondrogianni and Marinis (2011) and Sorenson Duncan and Paradis (2018) found limited or no impact for parental L2 proficiency on lexical and morphological development, while they found it to predict syntactic measures (passive voice and wh-questions, and multiple clause sentences, respectively). In other cases, however, it was found to predict lexical ability (Hammer et al., 2012) and not found to be a predictive factor in use of multiple clause sentences (e.g., Paradis et al., 2017).

2.3.4 Summary of external factors

External factors can comprise the quantity and quality of language exposure the individual experiences and can involve direct (proximal) or indirect (distal) influences. Longer second language exposure is associated with increased lexical proficiency (e.g., Chondrogianni & Marinis, 2011) and accuracy of morphology (e.g., Paradis, 2011) and sentence structures (e.g., Paradis et al., 2017). However, measuring overall length of exposure to the target language is linearly related to age of onset and may therefore allow only a weak account of input effects (Stevens, 2006; Paradis, 2011; Unsworth et al., 2014). Input measured via the types of L2 environments that the individual attends has been shown to impact positively on language acquisition (e.g., Blom, 2010; Gathercole, 2002a, 2002b, 2002c; Gathercole, 200). However, as with an overall length of exposure measure, the language environment represents a broad overview of L2 input and there may be variation in the amount and characteristics of regular L2 exposure within these environments (Unsworth, 2013).

More fine-grained measures of input aim to capture a comprehensive representation of L2 input. These typically include cumulative measures of second language exposure and use at home, where studies show weak or no effects (e.g., Armon-Lotem et al., 2011; Unsworth, 2016a) while others have found this type of exposure to be the most important factor for proficiency of target sentence structures (e.g., DeCat, 2020; Roesch & Chondrogianni, 2016) Furthermore, studies which have included separate measures of input have found that language use at home has negligible effects for morphosyntax (Chondrogianni & Marinis, 2011; Paradis & Kirova, 2014; Paradis et al., 2017) while richness of the language environment shows positive effects (e.g., Paradis, 2011; Paradis et al., 2017).

It may also be the case that input effects are more apparent for language features which are acquired late in L1 acquisition as opposed to those which are acquired early (e.g., Ågren et al., 2014; De Cat, 2020; Roesch & Chondrogianni, 2016; Tsimpli, 2014; Unsworth et al., 2014).

In relation to distal input factors such as socio-economic status and parental second language proficiency, again findings are mixed. Some studies show socio-economic status to have no impact on linguistic scores (e.g., Armon-Lotem et al., 2011; Paradis et al., 2017), whereas others do find an effect (e.g., Bohman et al., 2010; Sorenson Duncan, 2017). However, it is noted that the impact of socio-economic status demonstrates a complex picture in which its effect can depend on whether the mother's education was completed in the first or second language (Sorenson Duncan, 2017) or when children have had longer exposure to the L2 (De Cat, 2020).

The influence of parental L2 proficiency is not often included in research on sequential bilingual acquisition and where this is included findings are mixed across studies and within studies which include different language domains. Both positive (e.g., Hammer et al., 2012) and negative (Chondrogianni & Marinis, 2011; Paradis, 2011) effects have been found for lexical development, limited or negative effects for morphological development (Chondrogianni & Marinis, 2011; Sorenson Duncan and Paradis, 2018), and both positive (Chondrogianni & Marinis, 2011; Sorenson Duncan and Paradis, 2018) and negative (Paradis et al., 2017) effects on syntactic measures.

Therefore, it is clear that, while external factors do affect children's linguistic development, there is still some way to go before we can really identify the exact type of effect and on which domain its impact manifests.

The following section will briefly consider some of the different ways language proficiency is measured in previous studies.

2.4 Cross-linguistic influence

As mentioned previously, cross-linguistic influence will not be included as a predictor variable in the statistical analysis of the present study. This is due to all participants speaking the same main first language (L1) at home (Arabic). Therefore, cross-linguistic influence from the L1 cannot be adequately determined. Nevertheless, prior linguistic knowledge is thought to be a crucial source which learners rely upon to facilitate the task of second language (L2) learning and therefore it is an important aspect to consider in terms of its impact on L2 proficiency (e.g., Ellis, 1997; Jarvis & Odlin, 2000). In light of this, this factor will be explored further here. This will include the following: brief descriptions and examples of what constitutes cross-linguistic influence (2.4.1); some of the main theories in this domain (2.4.2); previous research findings from investigations of this factor in sequential bilingual acquisition (2.4.3); examples of typological features present in the morphosyntax of the participants' L1 Arabic and the influence these may have on acquisition of the same features in L2 English (2.4.4).

2.4.1 Descriptions of cross-linguistic influence

Cross-linguistic influence is thought to be exhibited in different ways: the direct transfer of the L1 language feature to the L2; a preference for a language feature in the L2 that parallels the L1; or avoidance of a L2 feature which contrasts with the L1 feature for the same concept (Odlin, 2000). Jarvis and Odlin (2000) propose that cross-linguistic influence is a form of retention of the L1. This reflects the inclination of L2 learners in retaining aspects of the L1 to assist them in coping with the challenges of the new language. Some researchers (e.g., Selinker, 1972; Odlin, 1989; Jarvis & Odlin, 2000) refer to language affected by cross-linguistic influence as *interlanguage*. In this case the language has a form which deviates from the L1 and L2, but which is pervious to both linguistic domains (O'Brien, 2003; Rocca, 2007). Cross-linguistic influence is often observed as errors of commission (substituting the correct language feature with another incorrect language feature) which is often used when gaps in L2 knowledge surface (Paradis, 2011). In the following example, an L1 Korean child using L2 English, transfers the L1 Korean sentence final negation to the English structure.

(3) *I want this one no

[I don't want this one]

(Kwon & Han, 2008)

Cross-linguistic influence can also manifest as a constraint which may restrict the choices an individual makes when using the L2. This is often observed as a preference or overuse of language features in the L2 that parallels the L1. This can manifest as avoidance or omission of an L2 feature that contrasts with the L1 for the same concept (Paradis, 2011). In the following example, an L1 Spanish speaking child acquiring L2 English omits of the obligated particle (4). This may be attributed to the L1 verb-framed Spanish which incorporates particles with verbs, while English realises the particle separately.

(4) *She put her necklace

[She put on her necklace/ She put her necklace on]

(Gilkerson, 2006)

2.4.2 Theories of cross-linguistic influence

A number of theories have been proposed to account for the presence of cross-linguistic influence in the L2. One theory is the Full Transfer-Full Access Hypothesis (Schwartz & Sprouse, 1994). This theory proposes that individuals acquiring a L2 have full availability to universal grammar, and with this, full access to the intact mechanisms which drive L1 acquisition. Therefore, parameters set in L1 acquisition exhibit in the initial state of L2 acquisition consequently affecting the acquisition of L2 structures through transference of previously established L1 constructions (Gilkerson, 2007). This suggests that participants in the present study will transfer language features of their L1 Arabic to their L2 English, especially in the initial stages of L2 acquisition. However, full access to principles of universal grammar will mean that they can eventually restructure the parameters of the L2 based on the input they receive from the environment.

Another approach to cross-linguistic influence is Bilingual Bootstrapping (Gawlitzek-Maiwald and Tracy, 1996). This theory suggests that transfer occurs due to the simultaneous activation of the stored language systems of the L1 and L2. As bilinguals generally have a stronger and weaker language, one particular construction within a specific domain will develop more quickly in one language than the other (Gawlitzek-Maiwald, 2003). The mixing of language use in the interlanguage is a strategy where the weaker language profits from the stronger one through a pooling of resources effect, where it utilises the grammatical aspects acquired in the other language. Therefore, something acquired in language ’A’ provides a booster to language ‘B’ (Gawlitzek-Maiwald, 2003). This can be applied to sequential bilingual acquisition in childhood, where the generally stronger L1 (Arabic for the participants in the present study) in the initial stages provides 'assistance' to the weaker L2 (English for the participants in the present study) thus carrying over its features (Gawlitzek-Maiwald and Tracy, 1996).

Müller and Hulk (2001) propose that cross-linguistic influence is found in the domain of grammar where syntax interfaces with discourse and occurs when the languages involved share some structural characteristics, i.e., when there is a structural overlap between the two languages. In contrast to the structural overlap perspective, Strik and Pérez-Leroux (2011) propose that structural complexity is a better predictor of cross-linguistic influence. Their theory suggests that the language with a less complex syntactic construction will be transferred to the language with a more complex construction, regardless of the predictions of the structural overlap hypothesis.

Cross-linguistic influence has also been proposed to be a result of processing limitations (Serratrice et al., 2004). In this case, these limitations often manifest for bilinguals or L2 learner populations due to the higher processing demands they encounter which reduces the processing resources they have available. Consequently, this decreases their efficiency in processing interface phenomena and online comprehension compared to monolinguals. Indeed, bilinguals have been shown to have specific difficulties with linguistic structures at the syntax–discourse interface (e.g., Sorace & Serratrice, 2009). In contrast, these groups typically display very high performance on syntax proper and high accuracy with linguistic structures which are part of syntax–semantics interface phenomena (Lillo-Martin & Müller de Quadros, 2011). The difficulty L2 learners have at the syntax-discourse interface is thought to occur due to the higher processing demands they encounter when using syntactic structures in speech. Consequently, this reduces the processing resources they have available and affects the efficiency in processing these structures compared to monolinguals.

2.4.4 Cross-linguistic influence in sequential bilingual acquisition – previous research

Much of the research in terms of sequential bilingual children has focused on the investigation of the impact of shared structural typological features between the L1 and L2. It is thought that these shared typological features can create convergent target language constructs which can facilitate L2 progress, while different typological features may result in divergent patterns (e.g., Alexopoulou, 2020; Blom et al., 2012; Eckman, 1977; Gilkerson, 2007; Haznedar, 1997; McDonald, 2000; Murakami & Alexopoulou, 2016; Zdordenko, 2010). Analyses specifically focused on richly inflected language versus isolating L1s, in the acquisition and accuracy of L2 English inflection, have mostly found cross-linguistic influence effects (e.g., Blom et al., 2012; McDonald, 2000; Paradis, 2011; Zdorenko & Paradis, 2011). McDonald (2000) reported enduring cross-linguistic influence effects in grammaticality judgment tasks of Vietnamese and Spanish L1 learners acquiring L2 English, with the Spanish L1 learners exhibiting higher proficiency compared to the Vietnamese learners. This suggests richly inflected languages, such as Spanish, determine performance of L2 inflection, compared to L1 languages like Vietnamese which have no inflection. Zdordenko (2010) also found instances of cross-linguistic influence in examining the use of auxiliary BE with the progressive (i.e., to be doing) by speakers of various L1 backgrounds. Results showed that the L1 Arabic, Spanish and Hindi groups showed higher proficiency of the English morpheme, which was attributed to parallel structures evident in these languages. Paradis' (2005) study however, which investigated the use of tense marked morphemes in L2 English by children from ten different L1 backgrounds, revealed that accuracy of this morphology was unrelated to whether the L1 language was richly inflected or not. However, using the same corpus as Paradis, results from Blom et al's (2012) study contrast with the previous study's findings in relation to the third person singular inflection in L2 English. Results indicated that the richly inflected L1s had a significant effect on how quickly children acquired the third person singular inflection, compared to those with isolated morphological L1 features. However, according to Blom et al (2012), the children in the Paradis study were evaluated after a short length of exposure to L2 English (after 12 months), and it is possible that the emergence of L1 transfer effects take a longer time to manifest. Paradis (2011) also examined cross-linguistic influence via L1 typology in her study. Results suggested that the children's L1 and whether it marked for verbal agreement and tense, was a robust predictor of accuracy in the use of verbal morphology. In addition, in investigating the interface between morpho-syntax and semantics, by examining acquisition of the article system of English, Zdorenko and Paradis (2011) found that the interface article domain was problematic for child L2 learners and furthermore indicated that acquisition of articles was attributed to both developmental sequences and L1 transfer, although they concluded that they were predominantly developmental based.

Cross-linguistic influence has also been found in L2 acquisition at the syntactic level. Under a generative perspective, White (1996) proposes that, similarly to L1 acquisition, the task of the L2 learner is to acquire a grammar on the basis of deficient input. While this perspective holds that L1 acquisition is constrained by the principles and parameters of universal grammar (UG), differing views within this tradition in relation to L2 acquisition have been suggested. In research conducted by White (1990, 1991, 1992), she proposed that grammatical representations in L2 development can be understood in terms of cross-linguistic influence of parametric values from the learner's L1.

White’s study (1992) investigated the role of the Verb Movement Parameter by L1 French speakers of L2 English aged between 10-12 years old. The study found that subjects consistently allowed adverbs to intercede between thematic verbs and direct objects (e.g., *Mary watches often television). A comparison of French and English clause structures allowed White to attribute these errors to cross-linguistic influence from French where Subject Verb Adverb Object (SVAO) is a grammatical order (e.g., Marie regarde souvent la télévision).

A study by Burger (1992) also appears to support White’s (1992) proposal. Burger’s study investigated the Head Direction Parameter by analysing speech production data of relative clauses from a native-speaking Japanese child who was aged 4 and acquiring L2 English. In head-initial languages such as English and Spanish, the relative clause follows the head noun whereas in head-final languages like Japanese, the relative clause precedes the head noun. Findings from the study showed that the L1 impacted the L2 parameter setting as the child transferred the head-final structure from her L1 Japanese in producing English relative clauses. This result corresponds with an earlier study by Flynn (1989) which found that Spanish L1 subjects, in an elicitation speaking task, acquired the English relative clause structure much earlier than the Japanese L1 participants who, as with the previous study’s participant, placed the head-noun incorrectly. The researcher concluded that similarities in the syntactic typology of English and Spanish relative clauses licensed a facilitative effect in this case. In Harley’s (1989) study of English L1-French L2 children in a French immersion school setting, results showed that they transferred prepositions from English to their French L2. In addition, Haznedar's (1997) analysis of data from an L1 Turkish speaking child showed cross-linguistic influence of his L1's head-final word order in his production of L2 English which deviated from the target English head-initial L2 structure. And Unsworth's (2005) study of L1 English-L2 Dutch children acquiring direct object scrambling in L2 Dutch found cross-linguistic influence of L1 word order as they frequently used English word order rules when speaking in Dutch.

These studies appear to support Schwartz and Sprouse (1994) in their assertion of the Full Transfer-Full Access Hypothesis which claims that initial representation of the L2, is determined in its entirety by parametric values transferred from the learner's L1, consequently facilitating and inhibiting the acquisition of L2 structures through transference of previously established L1 constructions (Gilkerson, 2007). While the starting point is the L1 grammar; where the L2 input differs to the L1, there is a restructuring of parameters via full access to UG. Therefore, parameters set in L1 acquisition exhibit in the initial state of L2 acquisition however, through access to UG they are able to reset parameters not acquired in their L1. In contrast to White's hypothesis claiming the presence of cross-linguistic influence of parameter settings from the LI to the parameters of the L2, a study by Henry and Tangney (1996) found no evidence of this effect. Their study involved analysing data from the speech production of English L1 children acquiring L2 Irish in an immersion setting. Irish demonstrates clear differences to English in relation to verb movement as English is a Subject-Verb-Object language whereas Irish is Verb-Subject-Object. Therefore, this would involve learners resetting the parameter in relation to the strength of the V-feature of the head which must be strong to license verb raising. However, the authors found no sign of cross-linguistic influence from their L1 English to L2 Irish.

In summary, previous research findings show that there have been mixed findings in relation to whether cross-linguistic influence is present for morphosyntactic features in sequential bilingual acquisition. The following section will present some of the typological features present in the morphosyntax of Arabic.

2.4.4 Typological features of the participants' L1 Arabic

This section will present examples of the typological features present in the morphosyntax of the participants' L1 Arabic. This will include examples of inflectional morphemes and syntactic structures. While there is variation in the morphosyntax of the many different types of Arabic dialects, the examples will focus on Syrian and Sudanese Arabic as a number of the participants in the current study originate from these countries.

In terms of morphology, Arabic has a rich system of inflectional morphology. This is observed in the integration of different patterns of vowels which merge with consonant roots to represent past or present tense, or person, number and gender agreement (Aoun et al, 2010; Cavalli-Sforza et al, 2000; Ridha, 2015). Past tense in Arabic is commonly inflected for person, number and gender. However, there are some exceptions: in Sudanese Arabic, third person singular in masculine form remains in infinitive form; while in Syrian Arabic, it is marked with an accent on the first vowel. All other structures in past tense are inflected using suffix morphemes, as shown in the (2.1) which details past inflection in Sudanese Arabic for the verb 'to study'.

Table 2.1 Past inflection for the verb 'to write' in Syrian Arabic

1st sg. katabt	2nd sg.masc. katabt	3rd sg.masc. kátabt
	2nd sg.fem. katabti	3rd sg.fem. katabet
1st pl. katabna	2nd pl.masc. katabtu	3rd m.pl katabu
	2nd pl.fem. katabtu	3rd pl.fem. katabu

(Adapted from Farris 1975)

The present tense in Syrian Arabic carries agreement with prefixes. As shown in the following examples, third person singular forms also agree in gender. The following examples from Syrian Arabic show third person singular for the verb 'to write'.

(5) by-éktob 3rd sg.masc

[he writes]

(6) bt-éktob s 3rd sg.fem

[she writes]

In contrasting the Arabic examples above with English, it can be observed that both languages use inflected forms for third person singular and past tense. Therefore, it may be expected that this could entail ease of acquisition of the corresponding L2 English forms by the participants.

In terms of syntax, the following two structures from Arabic will be considered: passive voice and relative clauses. Typologically, Arabic may share more similarity to English in relation to relative clauses than to passive voice. For instance, Arabic does not permit the agent to appear on the surface structure of passive sentences (8) therefore forming or recognising the by-phrase in English may be problematic (Khalil, 1993).

(7) Active voice:

ḍaraba	al-waladu	al-binta
hit	the boy	the girl

"the boy hit the girl."

(8) Passive voice:

ḍuribat	al-bintu
was hit	the girl.

"the girl was hit."

(Alhussain, 2016)

Furthermore, the passive voice structure is used much less in Arabic and especially so in spoken form compared to English (Smith, 2001). However, while it is used in spoken form, albeit on a very limited basis, it has been noted that in some cases a topicalized construction using a dummy subject 'they' is preferred over the passive construction (Brustad, 2000).

Relative clauses in Arabic have a similar structure to English which includes the use of a complementizer (e.g., allaði or lli):

(9) Daaʕa l-kitaabu allaði ˇstaraytu-hu l- baari˥hata

lost.3ms the-book that bought.1s it yesterday

'The book that I bought yesterday is lost.'

(Aoun et al., 2010)

However, where they diverge is that while in English there is no resumptive pronoun in the position of the gap left by movement in either subject or object relative clauses, in Arabic, object relative clauses use the resumptive clitic pronoun ha to indicate the location of the relativized head of the relative clause (Albrini & Benmamoun, 2014; Aoun et al., 2010). The difference in use of the resumptive pronoun between subject and object relatives is shown in (7) and (8).

(10)	safer	maʕ	š-šab	lli
	Travelled.3s.m	with	the-young man	___ who
	bjištiʁil	bi-l-maktabi.		
	works	in-the-library		

"He travelled with the young man who works in the library"

(11)	ʔakalt	t-təffaaħa	lli laʔeit-	ha bi-t-tallaaži
	ate.1s	the-apple	that find.1s-	it in the refrigerator.

"I ate the apple that I found in the refrigerator"

(Albrini & Benmamoun, 2014)

Therefore, it may be the case that participants use the overt resumptive pronoun (or lack of this pronoun) as a cue to indicate whether the sentence is a subject or object relative clause. However, the absence of an equivalent cue in English may hinder accurate interpretation.

In summary, the typological similarities and differences between the participants' L1 Arabic and the equivalent structures in English may influence their proficiency of the target morphosyntactic features in present study. Using the typological features presented above, it may be the case that participants will have less difficulty and therefore demonstrate greater proficiency with those features in English which have more similarity to Arabic. In contrast, the participants may have more difficulty and therefore demonstrate less proficiency with those features in English which are less similar to Arabic. Therefore, participants may have more proficient use and understanding of past and present tense morphology and subject relative clauses, and less proficient use and understanding of passive voice and object relative clause sentences.

2.5 Measuring language proficiency

This section will explore tasks used in previous studies to measure lexical (2.5.1), morphological (2.5.2), and syntactic (2.5.3) features of language with bilingual participants. Each part will begin with a short overview in relation to development in each domain.

2.5.1 Measuring lexical proficiency

Lexical knowledge is known to develop rapidly in childhood but continues to expand during the lifetime as the individual gains more exposure to different language experiences (Read, 2000). The knowledge and use of lexical items can depend on the individual's cognitive processes in storing and retrieving words. While storage of lexical items is typically consistent and unrestricted, retrieval of words can be changeable and affected by a number of factors including how often the item is accessed, how recently it has been learned, internal and environmental cues, and whether there is competition from other words in the lexicon (Nippold, 2007). In acquisition of new words, it has been found that children who have more extensive knowledge of a word through direct experience will be able to retrieve that item from memory with greater accuracy and speed than those who have less direct experience of the word (e.g., a pictorial reference as opposed to a real world reference) (McGregor et al., 2002, cited in Nippold, 2007). Lexical development has been shown to improve as children get older and develop better skills in storing and retrieving lexical items (Nippold, 2007).

Previous research comparing the lexical development of bilingual and monolingual speaking children appears to show that bilinguals significantly lag behind their monolingual peers (Oller & Eilers, 2002). However, other research suggests that the gap between native and non-native speaking children may not be so wide (Golberg et al., 2008). Nevertheless, bilingual children often do not attain the same lexical proficiency of age-matched monolinguals. This indicates that bilingual children should not be expected to develop the same lexical knowledge as their monolingual peers within the same timeframe (Paradis et al., 2011). The reasons for this protracted development may be related to a number of factors. The shared distribution of bilinguals' linguistic exposure between two languages naturally impacts vocabulary size in each language (Golberg et al, 2008; Hoff & Naigles, 2002; Kohnert & Kan, 2005). Another reason is that native speakers are constantly acquiring and accumulating new lexical knowledge throughout their lifespan and may therefore often be a stage ahead of their bilingual peers (Paradis et al., 2007). Additionally, bilinguals have to contend with competition from another lexical system (either the L1 or L2) which may impact the speed and accuracy of retrieving target lexical items. Another important aspect to consider in assessing the lexical knowledge of bilingual children is linguistic or cultural bias. Bilinguals' linguistic experiences often cross two different cultural contexts (Chueng et al., 2018) therefore, the lexical items included in a vocabulary assessment, which are typically normed for native speaking children in a particular country (e.g., typically the United States or United Kingdom for English language versions of language assessments), might not comprise the lexical items known to the non-native language learners and therefore the assessment may not be able to capture a full picture of the bilingual child's lexical proficiency (Chueng et al., 2018).

Different measures have been used to test lexical development. In second language acquisition, assessment can take the form of either a discrete or an embedded measure. The discrete approach consists of tasks which are selective and measure the individual's knowledge of specific word meanings as independent constructs separate from other features of language competence and without contextual information (e.g., assessing lexical knowledge through a vocabulary size test) (Read, 2000). In contrast, an embedded measure assesses vocabulary as part of a larger construct which can also assess other aspects of the individual's linguistic knowledge such as syntax, register, cohesion and use of context (e.g., assessment through reading, listening, writing or speaking tasks) (Bachman & Palmer, 1996; Read, 2000).

In addition, measures of lexical diversity in language acquisition research typically involve one of two kinds: type-token ratio in speech sampling; and standardised tests measuring vocabulary size.

Analysis of target lexical items in speech sampling can involve quantifying the lexical variation or word frequency within the sample of speech or writing (Jarvis, 2013). A drawback in using this type of measure in determining lexical ability is that lexical diversity will vary greatly in relation to the sample size, and a smaller sample may represent too little information to be able to generalise from (Jarvis, 2002; Jarvis, 2013; Malvern et al., 2004; McCarthy & Jarvis, 2010).

Standardised lexical tests can include receptive (e.g., The British Picture Vocabulary Scale, Dunn et al. 1997; The Peabody Picture Vocabulary Test, Dunn & Dunn, 1997) or expressive (e.g., The Renfrew Language Scales; Renfrew, 1995) evaluations of lexical ability. An assessment of children's expressive lexical ability in picture-naming tasks typically presents singular, pictorially represented, concrete objects which subjects are asked to name without cues to help them decipher the word (Blom & Bosma, 2016; Cheung et al., 2018). In contrast, receptive lexical assessments often involve reasoning and excluding options of multiple-choice pictures with cues regarding the meaning of the words. Standardised tests are typically easy to set up and administer, and as the same lexical items are tested with participants, a reliable comparison of abilities is permitted across the cohort.

2.5.2 Measuring morphological proficiency

Acquiring the interpretation of words of the target language can involve learning the variation of the internal structure of lexical items which are often realised through inflectional morphology (Haspelmath & Sims, 2010). In English, inflectional morphemes can involve affixal, suppletive, and auxiliary structures which change the word's infinitive form to a finite grammatical context. In English, affixal morphemes can hold tense, person, number, or aspect (e.g., third person singular, past tense, or progressive) represented by binding an affixal morpheme to a lexical stem (e.g., –s for third person singular, -ed for past tense, and –ing for present progressive) (Haspelmath & Sims, 2010; Nippold, 2007). While these forms tend to follow regular patterns, suppletive forms of morphological transformation or changes in the vowel elements within the stem, are also common in English, as seen in the irregular past tense forms (e.g., went for go, or ran for run). Children acquiring English sequentially often have difficulties with morphology as seen in errors of omission (e.g., 'She walk' for 'She walks') and commission (e.g., 'I maked four' for 'I made four') errors (Dulay & Burt, 1973, 1974; Haznedar, 2001; Ionin & Wexler, 2002; Jia & Fuse, 2007; Logue, 2016; Paradis, 2005, 2008; Paradis et al., 2008).

A common method for evaluating morphosyntax in a language sample is to calculate the Mean Length of Utterance (MLU). MLU refers to the average number of morphemes per utterance, calculated from numerous utterances in a language sample of a child's spontaneous speech (Paradis et al., 2011). Language samples which have a higher number of morphemes or function words result in higher MLUs. Some studies (e.g., Snedeker et al., 2007; Jia & Fuse, 2007) also evaluate the proficiency of morphological features through recordings of children's spontaneous speech and analysing their use in obligatory contexts. Inclusion of natural language from spontaneous speech allows instinctive language to be recorded which means a richer measure of speech production is captured. Yet, this also means there will be much variation between subjects thus reducing comparability across a cohort (Rocca, 2007; Granger, 2011). In addition, composite measures can be impacted by the frequency of features in language samples which can create discrepancies between scores for morphemes. For instance, opportunities for use of copula is can arise frequently in spontaneous speech while opportunities for using past regular morphemes can be fewer (Hadley & Short, 2005, cited in Oetting & Hadley, 2017). Another drawback of using language sampling is the time-consuming nature in obtaining sufficient language samples, and in transcribing, coding and analysing the data.

Elicitation tasks are another commonly used measure of morphological proficiency in language acquisition studies (Blom & Bosma, 2016; Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; Paradis & Blom, 2016; Snow & Hoefnagel-Hohle, 1978; Unsworth, 2016a). Elicitation of morphemes are sometimes part of a standardized language assessment tool (e.g., Clinical Evaluation of Language Fundamentals, Wiig et al., 2013). However, norm-referenced tests are often used to identify overall language deficits and therefore contain a limited number of items for evaluating particular structures (Oetting & Hadley, 2017). In contrast, criterion-referenced tools (e.g., Test of Early Grammatical Impairment; TEGI, Rice & Wexler, 2001) include a high number of specific target items which can offer more thorough and descriptive characterisations of morphological proficiency. As well as measuring production of target morphology some tasks also include a grammaticality judgement probe[7].

2.5.3 Measuring syntactic proficiency

In native language acquisition, typically developing children acquire the basic syntax of their L1 by age 3-4 (Guasti, 2002). Realisation of more complex syntax, semantics, and pragmatics; which contribute to elaborate forms of language convention as well as spoken and written registers; typically occur later in childhood, during their time at school (Nippold, 1998). Research investigating the acquisition of syntactic phenomena such as VO/OV, V2 placement, and subject–

[7] Including grammaticality judgements alongside production of target morphology may allow a fuller evaluation of morphological proficiency. For instance, a lack of surface morpho-phonological forms may not necessarily specify an underlying grammatical deficiency as proposed by the Missing Surface Inflection Hypothesis (Grondin and White, 1996; Haznedar and Schwartz, 1997; Haznedar, 2001; Lardiere, 1999, Prévost and White, 2000; Ionin and Wexler, 2002, White, 2003). In this case, optionality in use of inflectional morphology may suggest difficulty in realising surface forms (i.e., mapping between abstract features and surface structures) which can be related to a mismatch of syntactic and phonological features, rather than a fundamental deficit in morphological knowledge.

verb inversion by sequential bilinguals, shows that these features appear somewhat unproblematic for this population (e.g., Henry & Tangney, 1996; Haznedar, 2001; Blom, 2006; Rothweiler, 2006). More recently, Paradis et al. (2017) found that sentence structures which included coordinate, complement, adverbial, and relative clauses, were produced by child second language learners even when their exposure was very limited (in some cases, a few months). Nevertheless, as we have seen throughout the literature review, a number of difference factors can impact the language acquisition of syntax (and other language features) for sequential bilingual children.

In terms of measuring children's syntactic proficiency, interpretation and production is often evaluated through the administration of sentence repetition, truth value judgement, picture matching or selection, or language sampling including narrative production (e.g., Chondrogianni & Marinis, 2011; De Cat, 2020; Paradis et al., 2017; Rothman et al., 2016; Unsworth, 2016).

A common procedure included in standardised tests involves a multiple-choice picture matching task where participants are asked to choose the picture which best represents the sentence heard (e.g., the Diagnostic Evaluation of Language Variation, DELV, Seymour et al., 2005). However, using picture-selection tasks, whereby the participant is asked to think about the structure of sentences and make acceptability judgments has drawbacks in relation to the individual's cognitive skills (Marinis, 2010). For instance, these types of tasks put greater demand on processing as subjects must hold a sentence in mind while processing the actions in a number of different pictures (Frizelle et al., 2019). Therefore, individuals with greater memory capacity (which typically reflects the cognitive skills of older children) may find this task easier than those with reduced memory capacity thus, working memory (or age) may prove a confounding variable (Marinis, 2010). Another limitation in relation to picture-selection tasks is that subjects have time to reflect on the given structure before making a choice thereby utilising explicit understanding of language which again can bias those with higher cognitive, or more specifically, metalinguistic skills (Marinis, 2010). Therefore, a subject's performance on picture matching tasks may in fact reflect non-linguistic (in this case, cognitive) as opposed to linguistic skills and therefore not present a true measurement of their knowledge of the target structures.

A type of picture selection task which can reduce cognitive costs and processing load involves those in which only one picture per sentence is shown (e.g., Adani, 2011; Friedmann et al, 2009; Roesch & Chondrogianni, 2016). These pictures depict animal triplets (three animals) performing the same action on each other (two animals on the right and left of the picture are of the same type and one animal in the middle is of a different type). One character in the picture is the agent (doing the action) or patient (receiving the action) depicted by the verbs in the sentence, and the participant must choose the character doing or receiving the action as per the sentence given. As participants are not required to process the actions in a number of different pictures, the demand on cognitive processing should be much less than that required in multiple picture selection tasks. Therefore, the individual's cognitive ability should play a lesser role and a more accurate reading of language ability should be revealed.

Another common task type for measuring comprehension of sentence structures is a truth-value judgement task (TVJT, Crain & McKee, 1985; Crain & Thornton, 1998). Typically, a TVJT comprises a context presented in the form of a story which the examiner conveys to the participant, directly after which a sentence including the target structure which describes the context is given (Deevy, 2017; Gerard, 2016). The subject is then required to judge the truthfulness of the statement by processing the sentence structure and evaluating its meaning against the context described so that a truth value is calculated (Deevy, 2017). This task is thought to be less demanding than some other tasks (e.g., grammaticality judgement tasks) as it does not require the participant to analyse the input through metalinguistic means (Deevy, 2017). However, the set up of a TVJT requires careful consideration so that the context given does not favour one interpretation over another but allows both interpretations to be accessed equally (Schmitt & Miller, 2010).

The use of sentence repetition (also described as sentence imitation) draws on children's ability to repeat verbatim what was just heard (Theodorou et al., 2017). One hypothesis proposes that this particular test taps into the memory mechanism which is connected to language ability (Alloway & Gathercole, 2005). While it is a common evaluation of speech and language impairment, it is acknowledged to be a valuable assessment of language ability including that of the bilingual population (e.g., Chiat et al., 2013; Vinther, 2002). Sentence repetition has many advantages in that it is simple and quick to use and target language structures can be constructed exactly as required (Chiat et al., 2013). The logic of using these types of assessment is that participants will repeat sentences that they know better more accurately (Kidd et al., 2007). It has been hypothesised that in repeating a sentence the language user must employ an analysis and reconstruction of the utterance rather than passively imitating the structure (Lust, 2006; Potter & Lombardi, 1990). However, it has been stated that it is difficult to pinpoint which linguistic components sentence repetition actually target, and that the fact that it relies on short-term memory, may make it more difficult to disentangle the measurement of cognitive ability and language ability (Acheson & MacDonald 2009; Polišenská et al., 2015). In addition, this type of assessment may not appropriately engage children's attention throughout the task as it does not comprise elements which allow more active involvement from the children (e.g., tasks which involve an interactive element) and therefore participants may become disinterested and lose focus on the task.

Another common method of evaluating the syntactic proficiency of children is using a narrative production task. Narrative tasks can involve story generation through which subjects compose a story using picture cards, or through retelling a story after it has been narrated by the examiner. Narrative tasks can be used to evaluate a number of language components including the subject's grammatical skills and ability in organising a story in a meaningful and cohesive way using well-formulated sentences (Seiger-Gardner & Almodovar, 2017). According to Schneider et al. (2005), using narrative tasks involve a type of expression which is more frequently found in natural everyday life, requiring participants to use word combinations and sentences as opposed to target language use in isolation (e.g., specific words or sentences). However, narrative tasks involve the production of spontaneous speech which, as with any type of naturalistic speech, may result in a lack comparability between participants (Rocca, 2007; Granger, 2011). In addition, individual factors may also influence results whereby children who are more comfortable with storytelling or who are more naturally extroverted may be able to give fuller descriptions of the story pictures therefore affording them higher scores for this task. In addition, although production of language can tap the underlying understanding of the target structures to some extent, they may not provide explicit presentation of the comprehension of sentence structures (Lust, 2006). Therefore, production tasks may not provide a full depiction of the individuals' linguistic proficiency (Eisenbeiss, 2010).

In summary, a number of different tasks are used to measure language proficiency across domains including naturalistic production, elicitation, repetition, and interpretation through picture matching and truth value judgement tasks. Each task type may have advantages and disadvantages. Disadvantages of using some tasks include that they may inadvertently advantage one set of participants over another. For instance, older children compared to younger children may be able to utilise their conceivably higher cognitive skills in choosing the correct option in a multiple picture matching task. Therefore, it is important to give due consideration to including tasks which reduce the bias which can occur in measuring language and which may impact results.

The following section will summarise the findings of the review on internal and external individual difference factors and tasks used to measure language proficiency in sequential bilingual language acquisition.

2.6 Summary of literature review

This review of literature on sequential bilingual acquisition shows that while a number of factors appear to impact the language proficiency of this population, findings overall reveal a mixed picture across effects. While for the most part a later age of L2 onset and older chronological age predict greater vocabulary proficiency, a finding often linked to the higher cognitive abilities of older participants (e.g., Blom and Bosma, 2016; Collier, 1987; Golberg et al., 2008; Paradis, 2011; Snedeker et al., 2012; Snow & Hoefnagel-Hohle, 1978), these effects are less robust in the morphosyntactic domain with positive (e.g., Blom & Paradis, 2015; Paradis, 2011; Rothman et al., 2018; Paradis et al., 2017; Snow & Hoefnagel-Hohle, 1978), negative (Bedore et al., 2016; Jia and Fuse; 2007; Nishikawa, 2014; Roesch & Chondrogianni, 2016), or limited or no age effects (e.g., Snedeker et al., 2007; Blom & Bosma, 2016; Paradis & Blom, 2016; Unsworth, 2016a).

It is clear that an issue with measuring age effects is that they are intrinsically linked to other influencing factors. Age of onset is linearly dependent on an individual's length of exposure to the second language. Therefore, an earlier start to acquiring the second language may equate to more input and a later start to less input, thereby making it difficult to disentangle age and input effects. In addition, if length of exposure is controlled for (e.g., using two different age of onset groups who have the same months or years of exposure) it will be the case that the children with a later age of onset will be older and therefore able to utilise conceivably higher cognitive abilities which may assist their language proficiency. Therefore, later ages of L2 onset are complicated by higher cognitive abilities and linguistic experience making it difficult to appropriately evaluate critical or sensitive period effects.

Another important matter in relation to input is that in measuring the quantitative amount of exposure by way of calculating the time the child has been exposed to the second language may not reflect equal linguistic input across individuals. Language exposure can encompass different quantities and qualities depending on the individual's involvement in the second language at home, school, and outside of school, which can include participation in play and social activities with peers (Jia & Fuse, 2007; Paradis, 2011; Paradis et al., 2017). Including these more fine-grained factors can provide further insight into the individual's second language experience. Some fine-grained measures have included a cumulative measure of the quantity and quality of input evaluated over time (e.g., De Cat, 2020; Roesch & Chondrogianni, 2016; Unsworth, 2013). Studies including a cumulative measure of input illustrate that this can be a robust predictive factor of complex sentence structures including wh-questions (De Cat, 2020; Roesch & Chondrogianni, 2016), and passive voice and object relative clauses (De Cat, 2020) in sequential bilingualism. Other studies have evaluated fine-grained measures of input individually (e.g., Paradis, 2011; Paradis et al., 2017). Studies which have included separate measures of input factors have shown that language use at home does not impact language proficiency while richness of the individual's second language environment (e.g., the L2 activities they participate in) has a positive effect (e.g., Paradis, 2011; Paradis et al., 2017). Including fine-grained measures of input may not only evaluate a more accurate account of the impact of language exposure but may also help to distinguish which specific types of input impact L2 language acquisition.

Input can also involve indirect influences such as socio-economic status and parental L2 proficiency. Socio-economic status may interact with other factors (e.g., De Cat, 2020) therefore measuring interdependencies between factors may provide a more nuanced and holistic evaluation of the impact of factors on language proficiency and thus a fuller picture of these effects in bilingualism.

In considering a greater number of factors it may also be the case that these variables are correlated with each other, such as we have seen with age and both cognition and input, when one factor increases so does another. Therefore, while results may show an effect for one particular variable, it may in fact be the case that factors are confounded. Consequently, it is important to consider how to disentangle the collinearity between influencing factors. In some studies (e.g., Blom et al., 2012; Chondrogianni & Marinis, 2011; Paradis et al., 2017; Sorenson Duncan & Paradis, 2018) this has been achieved by not only measuring a number of influencing factors but also by incorporating particular data analyses (e.g., decorrelation of variables and/or backwards elimination for model selection). These types of measures will be examined further in the results chapter.

Tasks used to measure target structures may inadvertently advantage one set of participants over another: narrative elicitation may be easier to complete for children who are more naturally extroverted or who enjoy telling stories; while picture selection and sentence repetition may tap into cognitive abilities through being able to hold pictorial or spoken information in mind thereby advantaging those who have higher skills in this area. Therefore, it is important to consider including a task which reduces bias.

In summary, a number of factors may predict the linguistic proficiency in sequential bilingual acquisition which need to be taken into account and measured and analysed in such a way that collinearity is avoided and any bias reduced so that a more accurate prediction of factors can be achieved.

In the next chapter we will explore the notion of complexity in language, which specific features are considered complex, and present the rationale for inclusion of the target outcome measures.

3. Complexity

3.1 Introduction

The aim of this study is to investigate which factors known to influence sequential bilingual language acquisition impact proficiency of linguistic phenomena which is complex and non-complex. The inclusion of various language features and structures which are both complex and non-complex will allow us to observe how factors impact proficiency depending on their complexity. Linguistic complexity has been defined in different ways, and therefore this chapter will discuss the literature on this and present the rationale for inclusion of target outcome measures included in the study.

The chapter will be structured as follows. Complexity in language is explored and a discussion of its descriptions within linguistics and language acquisition is presented (3.2). After this, examples of structural complexity are described (3.3) followed by a more in depth look at specific examples of structurally complex forms including subordination and interveners (3.3.1), non-canonical word order (3.3.2), and morphologically complex features (3.3.3). The notion of cognitive complexity is then presented (3.4) followed by examples in relation to interveners in long-distance dependencies (3.4.1), non-canonical word order (3.4.2), and morphology (3.4.3). This section also includes an examination of frequency effects and cognitive complexity (3.4.4), and a brief overview of the language processing of complex features in L2 acquisition (3.4.5). The findings on language complexity are then summarised (3.5) and the final section presents the target grammatical phenomena and the rationale for their inclusion as morphosyntactic outcome measures in the current study (3.6). This is followed by the research questions which guide this thesis (3.7)

3.2 Complexity in language

The notion of complexity is applicable to many different domains of science and sociology whereby systems or entities are seen to consist of components which interact with one another to form complex patterns or constructions (Givón, 2008; Rind, 1999). Human language involves mapping meanings to sounds which, through particular structural arrangements, creates the capacity for greater expressive power (Anderson, 2015). While complexity is referred to frequently in research in linguistics and language acquisition, researchers often describe this construct in different ways (Bulté & Housen, 2012) and to put it simply, there is no go-to definition of which components count as complex. Descriptions of language complexity have been framed in different contexts: from a language evolutionary perspective; by comparing structures used in different languages to express similar concepts; and by how structural features diverge within a language itself.

From a language evolutionary perspective (concerning how languages change over time) complexity has been described in terms of economy and redundancy (e.g., Bickerton, 1995; Culicover, 2013; McWhorter, 2007; Smith, 1999; Trudgill, 1983). The term economy refers to achieving the greatest gain through the least possible effort. This reflects Zipf's (1949) Principle of Least Effort theory which proposes that human behaviour favours that which avoids excessive effort or expenditure. In the domain of language evolution, changes result from the requirement to express language in a clear, definitive way through the means of that which involves ease of effort and which produces more efficient language (Martinet, 1955). Consequently, less prominent linguistic forms may be removed or reduced and replaced with highly distinctive or more obvious forms (Vicentini, 2003). A proposed example from English is the change the inflectional system has undergone over time. Previously, English was a richly inflected language which later evolved to become morphologically impoverished relying more on articles and prepositions for marking agreement and having relatively fixed word order (van Gelderen, 2016). This can be seen when juxtaposing the Old English original sentence (1a) and the translation in (1b).

(1) (a) Þu to dæge þissum adem-est me fram duguðe and
2S to day this deprive-2S me from good and
adrif-est from earde minum.
drive-2S from earth mine

(b) 'You deprive me from good and drive me from my home.'

(Junius, Genesis 1031-3, cited in van Gelderen, 2016)

In contrast to economy, redundancy in language refers to that which is in abundance and which is repetitive. Redundancy can be viewed from a grammatical or contextual perspective. In the contextual setting it can have a positive quality: additional use of language can enhance a communicative event by adding to the interpretability of the discourse, e.g., via the language user emphasising particular words or phrases (2), or in resolving ambiguity (3) (Wit & Gillette, 1999).

(2) "I like coffee and you don't."

(3) "I live in Newcastle, in Northern Ireland."

In terms of grammar, redundant properties are those which are unnecessary and which add to the complexity of the language (Chiari, 2007). Grammatical redundancy manifests when there is more than one feature performing the same linguistic role but neither can be omitted (Wit & Gillette, 1999). An example used to show this is the -s suffix which marks third person singular form in English. As in (4) it is clear that the subject relates to a single person who is neither the first nor second person. Therefore, there are two features carrying out the same function (My sister and the -s morpheme) and despite this, the verbal inflection is obligatory. Thus, the -s morpheme is superfluous and results in a sentence which is unnecessarily more complex (Wit & Gillette, 1999; Juola, 2008).

(4) <u>My sister</u> read<u>s</u> the book.

Complexity can also be categorised by comparing the linguistic forms used by different languages to express similar thoughts and ideas. Within this context, McWhorter (2007) proposes a metric for measuring complexity between languages which includes the following areas: overspecification, structural elaboration, and irregularity. Overspecification refers to the extent languages vary in how they

> "overtly and obligatorily mark semantic distinctions" (McWhorter, 2007, p.21).

An example of overspecification in English is the use of definite and indefinite determiners for marking non-specificity of nouns (McWhorter, 2007). This characteristic is not evident across all languages, an example being Polish which lacks articles as seen in (5) (Smith, 2001). Therefore, in terms of overt and obligatory determiners, English is overspecified and therefore more complex in comparison to Polish.

(5)	Film	który widziałem	wczoraj
	The film	which I have seen	yesterday

Structural elaboration refers to characteristics of the grammar which deviate in terms of the rules required to produce structures (McWhorter, 2007). An example is the heterogenous word order patterns which contravene the typical grammatical, as opposed to pragmatic, word order found in a language. An illustration is V2 word order in German (6b) which diverges from the canonical subject-verb-object (SVO) form in matrix clauses (6a), and permits another component placed before the subject (topicalization).

(6)	(a)	Die Frau	liest	das Buch	
		The woman	reads	the book	
	(b)	Deshalb,	liest	die Frau	das Buch
		Therefore,	reads	the woman	the book
		'Therefore, the woman reads the book'			

The final example of McWhorter's metric for linguistic complexity is irregularity. Languages can vary in regard to the irregular forms they comprise. In English, examples of irregularity include verb and noun forms which are morphologically complex. Examples include ablaut or suppletive forms of past tense (e.g., go-went, sing–sang, drink–drank, think-thought) as they involve a deviation from the expected phonetic characteristics such as the typical -ed ending denoting past events used for regular verbs (McWhorter, 2007). Irregular phonetic features are also evident in the marking of plural nouns in English (e.g., child - children, loaf – loaves, mouse – mice, goose – geese); as well as the auxiliary verb be, which involves suppletive structures (am, are, is, was, were) which are unpredictable in comparison to the patterns of other verb forms in English (Aronoff & Fudeman, 2011). The notion of morphological complexity will be considered later in the chapter.

The main focus for this study in relation to complexity is exploring which language features of English are considered complex so that the study's target outcome measures comprise both complex and non-complex structures/features. This means we can explore whether the impact of factors is different depending on the complexity of language measures. In terms of how the linguistic features of a language differ in complexity, the literature often refers to complexity under the two categories of absolute and relative complexity (Bulté & Housen, 2012; Culicover, 2013; Dahl, 2004; Pallotti, 2015; Miestamo 2006, 2008). Absolute complexity, also referred to as structural complexity, describes the objective features or structural dimensions of an entity which include its morphosyntactic components and how these manifest (Culicover, 2013; Dahl, 2004; DeGraff, 2009; Givón, 2008; McWhorter, 2007; Miestamo 2006, 2008). In contrast to objective complexity, relative complexity refers to a linguistic property which produces an effort or is costly in terms of resources in processing or internalising the linguistic feature (Bulté & Housen, 2012; Culicover, 2013). In light of this, relative complexity has also been referred to as cognitive complexity or difficulty (Bulté & Housen, 2012). The following sections will consider examples of these types of complexity under the terms of structural (objective) and cognitive (relative) complexity. [8]

3.3 Structural complexity

Structural complexity has been described as simply an increase in the quantity of linguistic components in a sentence which include lexical, morphological, and clause-level items (e.g., Norris & Ortega, 2009; Bulté & Housen, 2012; Palotti, 2015). Therefore, the greater the number of these forms required or used, the more complex the structure is considered (Pallotti, 2015). However, some structures are considered more complex than others due to the more complicated syntactic relations they comprise e.g., subordinate clauses, interveners, and non-canonical word order (e.g., Bowerman, 1979; Boyle et al, 2013; Bulté & Housen, 2012; Givón, 2001; Diessel, 2004; Lust et al, 2009; Norris & Ortega, 2009; MacDonald & Christiansen, 2002; McWhorter, 2007; Palotti, 2015). Morphological complexity manifests when a number of morphemes are present within a lexical item (Németh et al., 2011). In addition, complexity has also been considered to manifest when a system's representation of features does not follow a given rule and instead

[8] An aim of this thesis is to explore descriptions of complexity so that a number of language features which are both complex and non-complex can be measured in relation to the effect of target factors on language proficiency. This exploration of complexity and what it comprises may allow us to make predictions as to the impact on language proficiency in terms of the target factors in the present study. However, it is beyond the scope of this research to specifically measure or disentangle any effect of different types of complexity (e.g., structural versus cognitive) on language proficiency.

involves irregular features which diverge from the dominant or frequent pattern found such as irregular morphological forms (Anderson, 2015; Battistella, 1996; Culicover, 2013; McWhorter, 2007). The following sections will review structures which comprise these language features including subordination and interveners (3.3.1), non-canonical word order (3.3.2), and regular and irregular morphology (3.3.3).

3.3.1 Structural complexity: subordination and interveners

Subordinate (or embedded) clauses are types of multiple clause structures comprising two or more propositions (each corresponding to a clause). While in co-ordinated clauses, phrases are linked together through the use of conjunctions (e.g., and, but, then, etc.) with each clause syntactically independent from the other; in subordinate clauses (e.g. complement, adverbial or relative clauses) the embedded clause serves as a constituent of the matrix clause (Bowerman, 1979). Relative clause constructions (7) include the main clause which is typically the structure's head noun, and the dependent relative clause(s) which modifies the head noun of the main clause (Bowerman, 1979; Wiechmann, 2015; Yamaguchi, 2013).

(7) The boy bought the toy <u>that he saw last week</u>.

Relative clauses may exhibit an event, part of which is under-represented within the relative clause either by way of a gap (8a) or through the use of a resumptive pronoun (8b) which obtains its interpretation from the head noun it is associated with (O'Grady, 2011).

(8) (a) The dog [CP that$_i$ you saw t_i __]…]

(b)

ʔakalt	t-təffaaħa	lli	laʔeit-ha	bi-t-tallaaži
ate.1s	the-apple	that	find.1s-it	in the refrigerator

"I ate the apple that I found in the refrigerator"

(Albrini & Benmamoun, 2014)

Various accounts aim to explain the derivation of relative clauses which include movement (e.g., Alexiadou et al., 2000) and base generation (e.g., Labelle, 1988, 1989, 1990, 1996) accounts. One influential analysis is the generative account which poses a transformational perspective in which relative clauses are manifested through operations which involve the movement a wh element from a clause-internal position to the specifier of a complementiser phrase linking the wh operator with the head noun (Figure 3.1) (Alexiadou et al., 2000; Guasti, 2002).

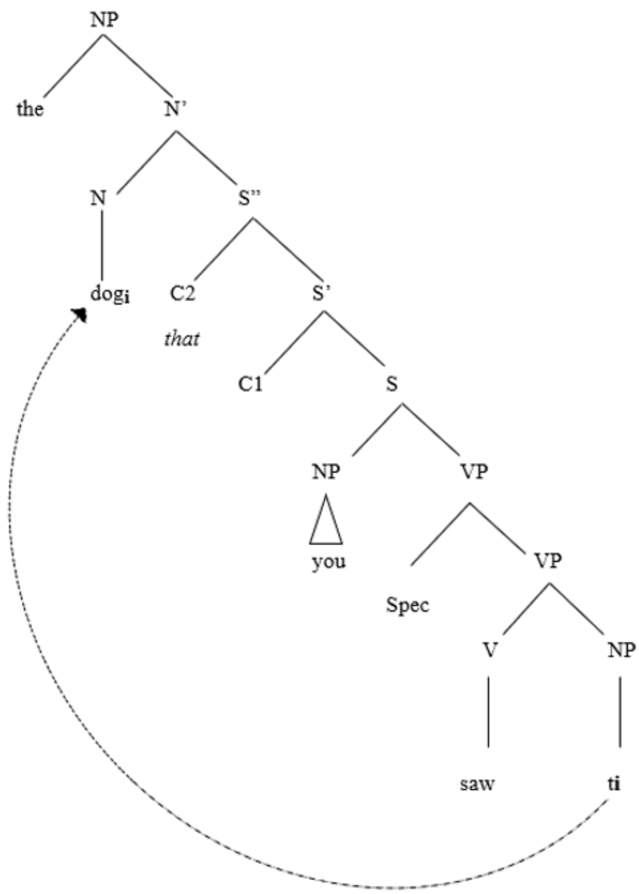

Figure 3. 1 Subordinate relative clause realised via movement.

While structures involving subordination may entail greater complexity compared to structures without subordination, other features within a subordinate structure may also contribute to the complexity of the structure. A prominent finding from the literature on relative clauses shows that object-headed relative clauses cause more difficulties both in comprehension and production compared to subject-headed relative clauses (e.g., Adani et al., 2010; Adani, 2011; Cook, 1975; Costa et al., 2011; McDaniel et al., 1998; Friedmann & Novogrodsky, 2004; Friedmann et al., 2009; Wanner & Maratos, 1978). This finding has been demonstrated cross-linguistically (e.g., Dutch: Frazier, 1987; German: Mecklinger et al., 1995, Schriefers et al.,1995; Hungarian: MacWhinney & Pleh, 1988; Hebrew: Arnon, 2005; Japanese: Miyamoto & Nakamura, 2003; Korean: Kwon et al., 2006, 2013), using different methodologies (e.g., eye-tracking: Traxler et al., 2002; event-related brain potentials: King & Kutas, 1995; magnetic resonance imaging: Caplan et al., 2001; self-paced reading: Gordon et al., 2001), in studies from second language acquisition (e.g., Doughty, 1991; Eckman et al., 1988; Gass, 1979; Wolfe-Quintero, 1992) and from research on language impairment (e.g., Frizelle & Fletcher, 2014; Riches et al., 2010). From a syntactic perspective, difficulties with object relative clauses in languages with post-nominal relative clauses such as English have been linked to locality constraints. While subject relative clauses comprise a short dependency between the head of the relative clause (the moved argument) and the gap (the place where it derives its thematic role) (9), object relative clauses require a longer distance dependency between these components (10) (Riches et al, 2010).

(9) [The dog$_i$ [CP that$_i$ t$_i$_ pushed the cat]…]

(10) [The cat [CP that$_i$ the dog pushed t$_i$_]…]

This involves A-bar movement of the object noun ('the cat') moving out of the main clause to the left periphery of the clause. This longer-distance dependency involves an intervening subject noun phrase. This phrase intervenes between the object head noun and the argument's original position (the complement of the verb) compared to no intervener in a subject relative clause (e.g., in (10) 'the dog' intervenes between the nominal head of the object and its original position). Inaccuracy may occur when the individual attempts to close the dependency rapidly and thus associates the dependency to the nearest argument, the subject position (Friedmann et al., 2009). This has been shown to occur if there is structural similarity (the same type of noun phrase) between the subject and object categories (e.g., Gordon et al., 200; Friedmann et al., 2009). This finding has been linked to a grammatical explanation of difficulty with relative clauses: the theory of Relativized Minimality (e.g., Friedmann et al., 2009; Grillo, 2009; Rizzi, 1990), which states that a local relation between two constituents cannot hold when another constituent intervenes. In the formation below (13), where X has moved from its original position of Y (the gap), locality constraints between X and Y fail when Z becomes a possible candidate for the local relation (Rizzi, 1990). This can transpire when the intervening constituent Z is lexically restricted, i.e., has a comparable structure (e.g., both are full DPs) in relation to X.

(13) X…Z…Y

This was shown in a study of 22 Hebrew-speaking children aged 3;7–5;0 whose comprehension and production of a number of different relative clause constructions was evaluated (Friedmann et al., 2009). The structures included: subject extracted relative clauses which have no intervening constituent, e.g. ‘Show me the cow that kisses the chicken’; object relative clauses where the target and intervening constituent diverge in terms of lexical restriction (one was a full DP and the other an arbitrary pro subject), e.g., ‘Show me the horse that someone is brushing’; and object relative clauses where both the target and intervening constituent are lexically restricted (both were full DPs), e.g., ‘Show me the chicken that the cow kisses’). Findings revealed that participants had no difficulties in comprehending and producing subject relative clauses (with no intervener) or the lexically diverse object relative clauses (in which the moved element and intervener differed). However, the children found the lexically restricted object relatives (comprising structurally similar DPs) problematic. Therefore, object relative clauses prove more complex when the intervener is structurally similar to the moved element.

3.3.2 Structural complexity and non-canonical word order

Canonicity describes sentences containing canonical word order which maps an Agent-Verb-Patient representation onto a Subject-Verb-Object phrase, as in an active transitive construction. Examples of canonical word order sentences include active voice, subject clefts, and subject relative clauses. In contrast, some structures permit a different order of components which deviate from the canonical form. Examples of non-canonical word orders are passive voice, object clefts and object relative clauses. The following section will consider the non-canonical word order of passive voice.

The canonical word order of grammatical and semantic components involves the subject category taking an agent reading and the object category taking a patient or theme reading as in English active voice (14). In contrast, passive voice in English permits a different order of components in the predicate whereby the patient is promoted and the agent demoted thus producing a ‘non-canonical’ word order sequence with the agent often placed after the verb in an optional by-phrase (15) (Wanner, 2009).

(14) The dog [AGENT] chased the cat [PATIENT]

(15) The cat [PATIENT] was chased by the dog [AGENT]

From a formal linguistic perspective, the realisation of the passive in English is motivated by syntactic principles including the Extended Projection Principle (Jaeggli, 1986) and the Case Filter (Vergnaud, 1977, 2008; Chomsky, 1981) which require the subject position of any sentence to be filled and the object requiring case in the absence of accusative case (since passive morphology 'absorbs' the accusative feature for the object, cf.Baker et al, 1989). Therefore, the noun phrase moves to the subject position satisfying both principles (the subject position is occupied, and the moved noun phrase receives case from the inflectional head of the clause), and an adjunct introduced via the by preposition is employed (Figure 3.2).

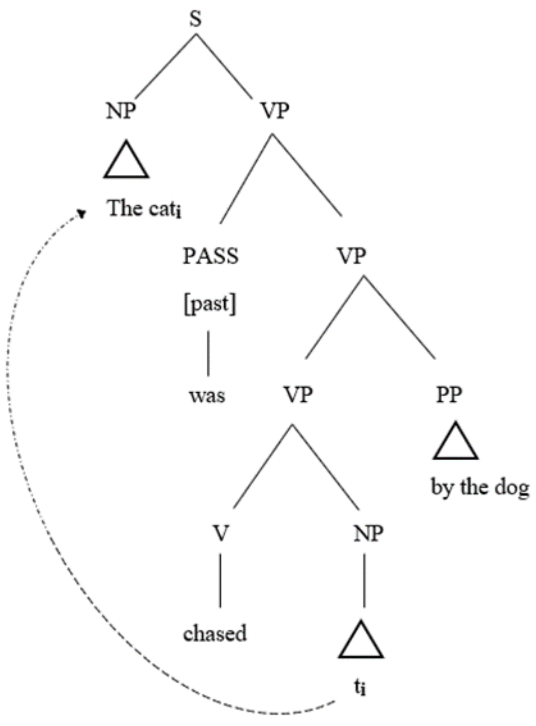

Figure 3. 2 Passive voice realised via movement.

Passives are also considered to comprise a number of other structurally complex features which can include whether it is a short or long passive[9]. While in first language acquisition, active voice is evident from the early production of multi-word structures around two years old, research on acquisition of the passive has found that difficulties can persist up until 6 or 7 years of age (e.g., Bever 1970; Borer et al., 1987; Brown, 1973; de Villiers & de Villiers 1985; Fox et al.,1995; Gavarró et al., 2011; Horgan 1978; Maratsos et al. 1985; Meints 1999; Orfitelli 2012).

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[9] Differences have been found between short (without the by-phrase) (16) and full (with the by-phrase) (17) passives with research showing that the production of short passives manifests much sooner than long passives (e.g., Fox & Grodzinsky, 1998).

(16) The window was broken.

(17) The window was broken by the boy.

Children's difficulties in acquiring the full passive construction have been linked to the maturation of syntactic constraints which manifest only when the appropriate processes mature. One such account, the Maturation Hypothesis (Borer et al., 1987), suggests that grammatical principles are acquired at different stages and that object-to-subject argument-chain (A-chain) establishment manifests at a later stage of development. Therefore, under this proposal children can access the 'short' adjectival passive construction as this does not require the object to undergo A-movement, while the full verbal passive construction manifests when children are able to access object to subject movement at a later stage in development. However, this theory has since been abandoned as it falsely predicts problems in the acquisition of simple intransitive sentences with unaccusative verbs which are acquired early (Pierce, 1992).

Intransitives are categorised as either unaccusative or unergative. While unergatives appoint an external theta role and are typically agentive, unaccusatives assign an internal theta role and are characteristically non-agentive. The case-filter motivates the object to move to subject position. Using data from the Child Language Data Exchange System (CHILDES, MacWhinney & Snow, 1985) in which the children ranged in age between 1 and 3 years old, Pierce (1992) showed that unaccusative intransitives (e.g., "all gone grape juice"; "there go horsie") were used frequently by the children.

Fox and Grodzinsky (1998) argue that children's difficulties with full passives only manifest when dealing with non-actional passives. Findings from their study revealed that children aged between 3-6 years old (n=13) interpreted short passives with high accuracy across both actional and non-actional types. However, performance between the short and full non-actional passives was split with interpretation of short non-actional above chance and full non-actional passives at chance indicating that the children had substantially more difficulties with full, non-actional passives. In contrast to associating difficulties with thematic role transmission to maturation, Fox and Grodzinsky (1998) propose that children encounter difficulties because they are unable to assign the external theta role of the verb phrase to the by-phrase by way of theta transmission. Instead, children are required to assign an agent (or affector) theta role to the complement. However, this is incompatible in the case of non-actional predicates and the resulting incoherence means the semantic interpretation is impossible. However, counter to the findings in Fox and Grodzinsky (1998) of a split between acquisition of actional and non-actional passives, other research (e.g. Hirsch & Wexler, 2006) which included a much higher number of participants (n=60), found that the vast majority of children under 6 years old demonstrated non-adult like comprehension for both short and full non-actional passives therefore suggesting that difficulties emerge due to non-actional verbs alone as opposed to non-actional verbs and a by-phrase.

3.3.3 Structural complexity and morphology

Morphological complexity manifests when a number of morphemes are present within a lexical item (Németh et al., 2011). Morphological components in language facilitate the expression of who, when, and how something was done. Acquiring the understanding of how these components, both within words and clauses, are added or changed to bring about particular semantic interpretations of a language, allows the language user to communicate more complex ideas. Therefore, acquisition of these components facilitates the building of more complex words and contribute to more complex sentence structures such as those presented in the preceding sections.

Acquiring semantic interpretation of words of the target language can involve acquiring or learning the variation of the internal structure of lexical items which are often realised through inflectional morphology (Haspelmath & Sims, 2010). In English, inflectional morphemes can involve affixal, suppletive, and auxiliary structures which change the word's infinitive form to a finite grammatical context. Inflectional morphology can express tense, person, number, or aspect (e.g., third person singular, past tense, or progressive) represented by binding an affixal morpheme to a lexical stem (e.g., –s for third person singular, -ed for past tense, and –ing for present progressive) (Haspelmath & Sims, 2010; Nippold, 2007).

While the preceding examples of affixal morphemes tend to follow regular patterns, suppletive forms of morphological transformation or changes in the vowel elements within the stem (ablauts) are also common in verb and noun forms in English, as seen in the irregular past tense, plural, or auxiliary forms. Irregular morphemes may be categorised as more complex than regular forms as they deviate from the dominant pattern found for morphological phenomena (Anderson, 2015; Battistella, 1996; Culicover, 2013; McWhorter, 2007; Paradis, 2010). Examples of irregular past tense in English include run-ran, bring-brought, draw-drew, take-took. As mentioned previously, irregular phonetic features are also evident in the marking of plural nouns in English (e.g., child - children); as well as the auxiliary verb be, which involves suppletive structures (am, are, is, was, were) which are unpredictable in comparison to the patterns of other verb forms in English (Aronoff & Fudeman, 2011).

Complexity in terms of morphology may also manifest due to differences in their allomorphic features. Allomorphy represents the variation of expressive phonological elements for the same semantic feature (Anderson, 2015). An example from English is the variation in phonological realisation of the regular past '-ed' inflectional form (Prasad, 2019). These can include: /ɪd/ as in 'banded'; /t/ as in 'fished'; and /d/ such as 'buzzed'.

3.3.4 Summary of structural complexity

Structurally complex language features are described as those which involve more complex syntactic relations such as subordination, interveners, and non-canonical word order. (e.g., Bowerman, 1979; Diessel, 2004; Givón, 2001; Friedmann et al., 2009; Lust et al, 2009; McWhorter, 2007; Norris & Ortega, 2009; Palotti, 2015; Riches et al, 2010). Subordinate clauses which involve intervening constituents are considered more complex than subordinate clauses without interveners (e.g., Friedmann et al., 2009). Examples of language structures which involve these more complex features in English, and can therefore be considered more structurally complex, are object relative clauses (comprises an intervener) and passive voice (comprises non-canonical word order).

In terms of morphology, complexity may arise when morphemes are present within a lexical item (Németh et al., 2011). Complexity is also described in terms of irregular linguistic forms. Irregular features of language are those which deviate from the expected form. One example from English are ablaut or suppletive morphological forms which can include irregular past tense morphemes. Another example is the variation in allomorphic phonological features of the regular -ed inflectional form of past tense in English. Therefore, while lexical items which contain morphological features are considered complex (e.g., the regular -s morpheme on third person singular), past tense is an example of a more complex morphological form as it contains variation in its allomorphic phonological features for the regular -ed morpheme and irregular forms of a number of verbs.

The following section will review complexity from a cognitive perspective.

3.4 Cognitive complexity

In contrast to structural complexity, cognitive (or relative) complexity refers to a linguistic property which produces an effort or is costly in terms of resources in processing the linguistic feature (Bulté & Housen, 2012; Culicover, 2013). In this case, the focus is on the individual and the inherent elements which influence the use and processing of language which may include the language user's memory capacity, language background, and language proficiency (Givón, 2001; Housen & Kuiken, 2009). Some researchers caution applying the cognitive/relative perspective in describing complexity positing that the difficulties associated with the individual do not produce complexity but arise from the complexity of the structure (e.g., Dahl, 2004; Pallotti, 2015; Rescher, 1998). On the other hand, Kusters (2008) proposes that the individual evaluates language from their own standpoint which encompasses separate linguistic and world knowledge and therefore what is complex for one person may not be for the next. This may apply to the bilingual compared to the monolingual participants in the current study who are at different stages of development in the target language (English) and who already have an established language system in place which may influence how the target language is acquired.

Cognitive complexity is associated with the difficulty that language users may have in processing language features (van Gompel, 2013). In typically developing native-speaking populations, language processing appears to occur in a rapid and effortless manner (Love & Swinney, 1998). Underlying this automaticity, a range of systems are utilised by the language user including phonological processing, accessing lexical interpretations and structural features, as well as using discourse-level procedures such as contextual and pragmatic cues (Love & Swinney, 1998; Snedeker, 2013). Processing sentence structures has been shown to be incremental, that is to say, the language user interprets the construction on a word-by-word basis rather than deferring interpretation until the end of the sentence (e.g., Just & Carpenter, 1980). In addition, sentence processing involves interpreting incoming data by building conceptual representations via word recognition which allows the formation of syntactic and semantic associations (Tanenhaus & Trueswell, 1995). However, the processing of some language features has been shown to involve a greater burden on language processing demonstrated by inaccuracies and by longer reaction times in accurately interpreting or producing target features as measured by online and offline methods (e.g., self-paced reading tasks, eye-tracking during reading, or event-related brain potentials) (van Gompel, 2013). Language features which demonstrate greater burden on language processing can include those with interveners in long-distance dependencies (e.g., object relative clauses), non-canonical word order (e.g., passive voice), or sentences which require the language user to carry out a revision of an original interpretation to come to the correct understanding (van Gompel, 2013). These examples of cognitively complex language features will be examined in the following sections (3.4.1-3.4.3). Cognitive complexity and frequency-based effects will also be explored (3.4.4). In addition, in taking an individual's viewpoint into consideration (e.g., Kusters, 2008), the processing of complex structures will also be considered from a second language learner perspective (3.4.5).

3.4.1 Cognitive complexity and interveners in long-distance dependencies

As with the subject-object asymmetry found in language acquisition for relative clauses, the same demarcation is found in the language processing literature whereby language users appear to have more difficulty (as evidenced by longer reaction times) in accurately processing object relative clauses in comparison to subject relative clauses (e.g., King & Just 1991; Just & Carpenter, 1992; Traxler et al., 2002). One explanation of the processing difficulties of object relative clauses includes memory limitations (Gordon & Lowder, 2012). Subject extracted relative clauses place less burden on cognitive cost as the subject can be assigned directly to the verb and therefore integrated into the relative clause without much difficulty (18) (van Gompel, 2013). In contrast, processing object relative clauses entail a greater distance between the object head noun and the gap (19). Furthermore, language users must retain in memory the dependency between the head noun and the verb while interpreting the intervening subject noun phrase (Wanner & Maratsos, 1978).

(18) [The dog$_i$ [CP that$_i$ t$_i$ pushed the cat]]…

(19) [The cat [CP that$_i$ the dog pushed t$_i$]]…

As working memory resources are engaged in processing referential components of the sentence, this results in reduced accessibility for memory to preserve the syntactic representations of the sentence (Warren & Gibson, 2005). Attempting to bring about the correct interpretation results in a short-term burden on computational resources in processing the structure thus contributing to inaccuracy (e.g., Adani, 2011; Chen et al., 2005; Gordon et al., 2001; Just & Carpenter, 1992; King & Just 1991; Miller & Isard, 1964; O'Grady, 1997; Riches et al., 2010; Traxler et al., 2002).

Difficulties with processing object extracted relative clauses are also attributed to cue-based interference (e.g., Van Dyke & Lewis, 2003; Lewis & Vasishth 2005; Lewis et al., 2006). This proposal sees parsing difficulties linked to how memory encodes, stores, and retrieves information from the cues of constituents (DPs) in the sentence. In an object relative clause, the nominal DP is encoded and stored in memory and later when the gap is encountered it is retrieved. However, if a new constituent with comparable cues to the one already stored in memory intervenes, this additional set of cues can obstruct processing of the first element and heighten burden on processing costs. Therefore, limitations in processing object relative clauses occur when two similar components within the sentence are retrieved simultaneously which results in an interference in working memory. This proposal is similar to that made by Friedmann et al. (2009) in which complexity arises when the moved and intervening constituent are lexically restricted (i.e., share a comparable structure).

In a study by Clahsen and Felser (2006), they compared the real-time processing of filler-gap dependencies in German by three different language learning populations: adult native speakers; child native speakers; and adult second language learners. Their results revealed that overall, children were slower than adults in processing these sentences. However, both children and adult native speakers with high working memory (as demonstrated through a digit span test) exhibited a similar language processing strategy in that the filler was mentally reactivated at the gap. In contrast, both child and adult participants with low working memory also patterned similarly in that neither group demonstrated any filler reactivation effects at the gap position. Therefore, differences in processing the structures were due to working memory limitations as opposed to biological effects. However, the authors propose that differences in overall reaction times between the children and adults were due to global differences between the two populations in relation to working memory capacity and efficient retrieval of lexical items.

In a study by Booth et al. (2000), 8-12 year old children demonstrated much slower reactions in the processing of object relative clauses compared to subject relative clauses. This specifically related to the section immediately after the embedded verb. Interestingly, the study also found that children with higher working memory ability, as shown by way of a digit span test, were slower at processing this key part of object relatives, i.e., at the periphery between the relative clause and main clause. The authors propose that children with higher working memory make more effective use of these skills when they are required.

Language features which have interveners in long-distance dependencies such as object relative clauses, place more processing demands on the language user attempting to parse these structures. Therefore, object relative clauses can be described as a cognitively complex language structure. As memory appears to be an impacting factor for the accurate processing of this structure, it is expected that those with higher working memory capacities will be more accurate in processing these structures.

3.4.2 Cognitive complexity and non-canonical word order

Non-canonical structures are also shown to cause processing difficulties, one example being passive voice (e.g., Ferreira, 2003: Marinis, 2007; Stromswold, 2004). As reported previously in the section on non-canonicity and structural complexity, non-canonical word order involves the patient being promoted to the subject position and the agent demoted and often placed after the verb in an optional by-phrase (21) (Wanner, 2009).

(20) The dog [AGENT] chased the cat [PATIENT]

(21) The cat [PATIENT] was chased by the dog [AGENT]

Previous research reports non-canonicity as a cause of difficulty in terms of processing language structures for both children and adults who tend to demonstrate a preference for processing canonical word order (e.g., Bates & MacWhinney, 1982; Bever, 1970; Ferreira, 2003; Montgomery et al, 2008; Robertson & Joanisse, 2010; Slobin & Bever, 1982; Townsend & Bever, 2001). Difficulties are thought to manifest as passives involve a revision in mapping the non-canonical semantic roles and grammatical categories for the correct interpretation thus increasing the parsing load and impacting competency (Ferreira, 2003). Results from Ferreira's study found that typical adult language users initially processed the first noun phrase in passives (and non-canonical object clefts) as the agent of the sentence.[10] Ferreira suggests that this is due to a preference for canonical sentences which assign the agent role to the subject category. Therefore, language users assume the first NP is the subject and assigns it the role of agent. However, once the past particle of the verb is encountered, the language user recognises that a passive reading is required and therefore a revision must take place in which the thematic role of the subject is changed from agent to patient. In addition, the by-phrase may involve a locative or agentive reading depending on the properties of the NP.[11] Once the agentive properties of the passive by-phrase are established then the thematic role of the agent needs to be transferred to the by-phrase. Therefore, in violating canonical word order, processing of the passive voice construction involves a number of cognitively complex processes: analysis of morphological cues on the verb, re-evaluation of semantic roles, and establishing an agentive reading of the by-phrase. Ferreira (2003) suggests that difficulties in processing the passive involve language users engaging in simple processing strategies which result in opting for the most frequent paradigm in which the subject occurs before the object as found in the active voice construction.

As already shown, compared to adults, children demonstrate reduced linguistic accuracy of some structures described as complex which may be due to different language processing strategies between the two groups (e.g., Clahsen & Felser, 2006). Research examining the interpretation and processing of active and passive voice using eye tracking and a picture matching task (Stromswold, 2004) revealed

[10] In Ferreira's (2003) study, native English-speaking adults were asked to identify the semantic roles in sentences with active and passive structures and subject and object clefts. In English, a cleft sentence is used to add focus or emphasis to a particular part of the sentence by moving it from its original position either as the subject or object of the verb.

(22)	The man bit the dog	(Active)
(23)	It was the man who bit the dog	(Subject cleft)
(24)	The dog the man bit	(Passive)
(25)	It was the dog the man bit	(Object cleft)

Findings showed that participants had more difficulties (were slower and less accurate) in identifying the semantic roles in both passives and object clefts compared to actives and subject clefts.

[11] Locative *by* phrase: The cat was kissed *by the lake*. Agentive *by* phrase: The cat was kissed *by the dog*.

that the children (aged between 3 and 8 years old) and adults processed passive sentences differently. While both adults and children had higher accuracy in interpreting active sentences compared to passives with longer reaction times demonstrated for the accurate passives, the children had much slower reaction times for processing the passive constructions. This may, in part, be related to how they processed this structure. While the adults matched the correct picture with the sentence at the passive participle; the children looked at the matching picture at the end of the sentence. From these findings Stromswold proposed that in interpreting passives, adults make use of morphological cues and process the passive online. In contrast, children process the first noun phrase as the agent of the sentence and only apply the passive interpretation offline, i.e., after the full sentence has been heard, therefore contributing to the longer reaction times. However, in contrast, Huang et al. (2013) found similar results for both the child (5 years old) and adult Mandarin speakers in their study. Participants were tested on passives with early and late role assignment. Eye-tracking revealed that both sets of participants were much more accurate with interpretation of the early role assignment structures, indicating that when a revision of an original interpretation was not needed, accuracy was much better.

In summary, non-canonical structures in comparison to canonical structures put more burden on processing and extra effort is required to process these structures accurately. Therefore, non-canonical structures can be described as cognitively complex language features. Due to the demand on cognitive processing, it is likely that the older participants (who conceivably have greater cognitive skills) and those with greater memory capacity in the current study, will be able to utilise these skills to process the cues more accurately.

3.4.3 Cognitive complexity and morphology

As presented in Section 3.3.3 on morphology and structural complexity, morphologically complex words are those which contain inflectional morphemes. More complex morphological forms involve those which include different morphological and phonological patterns to mark the grammatical feature such as past tense morphology in English as it involves both regular and irregular morphemes and a variety of allomorphic forms to mark the regular -ed affix.

The processing of morphologically complex words is considered to manifest in one of two ways: via whole-word processing (e.g., Butterworth, 1983) through a single-system approach (Bybee, 1995; Elman et al., 1996); or via whole-word processing and decomposition (e.g., Taft, 1994) through a dual-system approach (e.g., Pinker, 1999; Pinker & Ullman, 2002). In the whole-word processing method, the morphologically complex word is not processed by breaking the item down into component parts but is stored or memorised and thus processed as an individual entry within the mental lexicon (de Zeeuw et al., 2013). Thus, in this single-system approach, regular and irregular morphemes are considered to be processed via one mechanism (Bybee, 1995). In contrast, the decomposition proposal sees analysis of the breakdown of component parts of morphologically complex words. Therefore, the dual-system approach proposes that regular morphology (e.g., with -ed morphemes for past tense morphology, or -s for third person singular morphology) is processed via a rule-based mechanism (stem + affix), while irregular morphemes (e.g., ablaut or suppletive forms such as went, ran, or sang) are processed via a single-system approach (e.g., Pinker, 1999; Pinker & Ullman, 2002). Regular morphologically complex words may be processed via both mechanisms (as whole words and through decomposition) (Alegre & Gordon, 1999). This results in an advantage for the processing of regular morphologically complex words compared to irregular morphologically complex words as irregular morphology can only be processed via the single-system approach (de Zeeuw et al., 2013)

A number of studies have shown greater accuracy with regular as opposed to irregular morphology (e.g., de Zeeuw et al.,2013; Paradis et al., 2007; Paradis et al., 2010; Nicoladis et al., 2007; Ullman et al., 2005). A study by Paradis et al. (2010) investigated regular and irregular past morphology in English and French by both monolingual and English-French bilingual children (mean age 4;10). Findings from the study demonstrated that both bilingual and monolingual children were less accurate with irregular compared to regular morphology in both languages.

In addition, regular inflectional morphology may be facilitated by their consistent morpho-phonological markers while irregular past tense forms may be obstructed owing to their inconsistent morpho-phonological markers (ablaut and suppletive inflectional morphology). Due to this, processing efficiency of irregular past tense morphemes may rely more so on whether they have a high token frequency in the input for language users to be able to process them efficiently (de Zeeuw et al.,2013). If the token frequency of regular and irregular forms are similar, then regular forms will have an advantage over irregular forms due to their consistent morpho-phonological marking. A study by de Zeeuw et al. (2013) investigated Dutch L1 and L2 children's processing of regular and irregular past tense morphology. Participants were in either the third or sixth grades of school. The researchers matched both regular and irregular past tense verb forms on frequency (lemma and lexeme frequency) so that results could not be attributed to token frequency effects. Findings showed that both language background groups at both stages of schooling (third and sixth grade) were more accurate with the regular past tense verbs. Therefore, even when token frequency effects correspond, regular morphological forms are easier to process likely due to their consistent morpho-phonological markers. In addition, the study found that while the Dutch L1 children were more accurate than the Dutch L2 children with irregular past tense morphology in the third grade, differences were not evident between language background groups in the sixth grade. The authors propose that the children in the later primary school year (sixth grade), who had had more exposure time to Dutch compared to the children in the lower grade (third grade), were able to catch-up to their native-speaking peers as they had received an appropriate amount of exposure to be able to process the irregular forms efficiently. This has implications for the present study which will measure input effects and morphology whereby past tense may be impacted more by input measures compared to third person singular. This will be discussed further in light of the results.

In summary, irregular morphology such as past tense in English involve ablaut or suppletive forms which are cognitively complex compared to regular morphology for two reasons: (1) they have inconsistent morpho-phonological markers; (2) a rule-based mechanism may not be utilised when processing these features (e.g., Pinker, 1999; Pinker & Ullman, 2002). Instead, a single-system approach is applied for irregular past morphemes whereby these lexical items are retrieved and processed as separate entries in the mental lexicon (Butterworth, 1983; Bybee, 1995; de Zeeuw et al., 2013; Elman et al., 1996). Due to the greater cognitive complexity of irregular compared to regular morphology, children with higher memory skills or who are older and have conceivably greater cognitive capacities, will be more proficient in processing irregular morphology.

3.4.4 Cognitive complexity and frequency-based effects

Another source which may impact the processing of complex features is the experience of encountering and using them.

In relation to relative clauses, it is noted in corpus studies of English that object relative clauses are much less common in the input compared to subject relative clauses which may reduce the language user's performance in processing these structures (e.g., Gordon & Hendrick, 2005; Keenan 1975; Roland et al., 2007). In a study by Wells et al. (2009), adults' experience of object relative clauses was manipulated through reading experience. The relative clause experience group were given extensive practice in reading object relative clauses over a number of sessions (reading 80 subject relative clauses, 80 object relative clauses, and 80 filler sentences). In contrast, the control group received 80 sentential complement clause sentences and 80 filler sentences. Findings revealed that the reading time of object relative clauses in the relative clause experience group reduced significantly compared to the control group thus indicating significantly faster processing when experience of the structure was increased.

Related to the impact of reduced frequency of non-canonical order on the processing of passives, it has been shown that active and passive voice contrast in their frequency in child directed speech in English[12]. For children recorded between the ages of 1;6 and 5;1, the passive structure was rare, representing just 0.36% of child directed utterances by their adult caregivers (e.g., Gordon & Chafetz, 1990). Cross-linguistically, there appears to be a correlation between age of acquisition of passives and frequency in the input whereby languages which have a higher frequency of passive constructions in child directed speech (e.g., Sesotho, and Inuktitut) show children acquiring these at younger ages (from as young as 3 years

[12] The participants in the current study all speak Arabic as a first language. Passive voice in Arabic is also noted to be an infrequent structure and in fact, comparatively rare in comparison to passive voice in English as it is used much less especially in spoken form (Smith, 2001). Furthermore, while it is used on a limited basis in spoken form, a topicalized construction using a dummy subject 'they' is preferred over the passive construction (Brustad, 2000). This will be explored further in the discussion in light of the results.

old) (Demuth et al, 1989; Demuth, 1990; Allen & Crago, 1996; Demuth et al., 2010) compared to what is reported for English-speaking children. Input effects have also been reported in a priming study (e.g., Brooks & Tomasello, 1999) where they controlled the rate of 3-year-old children's linguistic exposure to passives by providing one of the two cohorts with a higher frequency of passive constructions comprising nonce verbs. Findings showed that only the group which were exposed to the full passive (i.e., with a by-phrase) produced this construction, while those who received the passive training showed significantly increased production of both short and full passives compared to the group which did not receive training.

In relation to the present study, it may be the case that children who have greater L2 exposure, and who therefore conceivably receive more exposure to L2 language features, will be more proficient in interpretation or use of these features.

3.4.5 Cognitive complexity and L2 acquisition

In relation to L2 language processing, it is unclear as to whether L2 users engage in the same sentence processing methods as native language speakers and how this contributes to their overall language competency (see Cunnings, 2017). Previous research has shown that L1 morphosyntactic structures can influence the acquisition of L2 structures (e.g., Haznedar, 1997; Unsworth, 2005) and it is proposed that the initial grammar of the L1 transfers to the L2 (e.g., Full Transfer/Full Access Model, Schwartz & Sprouse, 1996). Typological markedness in second language acquisition can impact the ease or difficulty that second language learners have in processing particular components of the language, with similar typological structures (in comparison to the L1) being easier to acquire than those with divergent typological structures (e.g., Alexopoulou, 2020; Blom et al., 2012; Eckman, 1977; Haznedar, 1997; Gilkerson, 2007; McDonald, 2000; Murakami & Alexopoulou, 2016; Zdordenko, 2010). In contrast, other research shows that L2 learners from different L1 backgrounds perform similarly when processing complex L2 sentences regardless of whether the L1 and L2 are comparable (e.g., Havik et al., 2009; Jackson & Dussias, 2009; Marinis et al., 2005; Roberts et al., 2008).

In Clahsen and Felser's (2006) study, they compared the processing of target morphosyntactic structures (e.g., long distance dependencies) between adult native speakers and adult second language learners. While findings revealed that both groups used similar processing methods, in that they both utilised lexical-semantic strategies, it was revealed that the L2 adults were guided much less by syntactic information. Reconciling this strategy for processing sentence structures in non-native language use, Clahsen and Felser suggest that syntactic representations for L2 users are shallower and less detailed than those of native speakers. From this, the authors posit the Shallow Structure Hypothesis which entails diminished sensitivity to syntactic or structural representations during processing and an increased sensitivity to lexical and pragmatic information. Conversely, other studies have shown that processing in L1 and L2 acquisition mostly follows the same procedures, but that divergence emerges due to differences in language users' proficiency or cognitive limitations (e.g., Dekydtspotter et al., 2006; Hopp, 2006, 2010; Jackson & Bobb, 2009; Jackson & van Hell, 2011; McDonald, 2006; McElree, 2000). Further to this, Cunnings (2016) proposes that the difficulties L2 users encounter when processing sentence structures are mainly due to accessing information from memory which they have previously stored during sentence processing to bring about accurate interpretation.

Furthermore, from the perspective of proficiency and cognition of L2 language users, under a cognitive theory on L2 acquisition-Processability theory (Pienemann, 1998), cognitive constraints impact the speech processing, lexical access, and memory capacity of L2 learners. Therefore, the capacity to use a linguistic structure is only exhibited if the necessary processing mechanisms are available to the learner. This theory assumes a universal hierarchy of acquisition which develops in the following sequence:

"the lemma (words) > the category procedure (lexical morphemes) > phrasal procedure (canonical mapping) > inter-phrasal procedure (non-canonical mapping) > inter-clausal procedure (long-distance dependencies)" (Pienemann, 1998, p.9).

Relative clauses are placed within the final procedural stage-the inter-clausal procedure, while passive voice is placed within the inter-phrasal procedure. Therefore, it is hypothesised that L2 learners need to build up a substantial inventory of linguistic processes before they have the capacity to use these complex sentences. In relation to the current study, the bilingual participants, who (overall) are at earlier stages of acquisition compared to the monolinguals, will be at an earlier procedural stage of development and may therefore not be as accurate with these more complex structures in comparison to the L1 children. In addition, it is likely that children who have increased experience in using the L2 will be at later procedural stages and therefore may be more accurate with these structures compared to those with less L2 input.

In relation to child L2 learners and sentence processing, Marinis (2007) and Marinis and Saddy (2013) investigated Turkish-English sequential bilinguals' sentence processing and comprehension of passive voice using both offline and online tasks. Findings from the studies revealed that while the sequential bilinguals were slower and less accurate with passives compared to the monolingual participants, they did not appear to differ from the native speakers in how they processed passives: both groups used morphological cues to revise and reassign thematic roles when required. The authors suggest that difficulties for children acquiring an L2 in processing the passive compared to monolinguals are attributed to their decreased exposure to the target L2. Therefore, in terms of the present study, it is likely that the bilingual participants, in comparison to the monolinguals, will be less accurate with passive voice structures. Additionally, bilingual participants with more L2 experience will likely exhibit more accuracy with passive voice.

3.4.6 Summary of cognitive complexity

In summary, language features which are cognitively complex include those with interveners in long distance dependencies with comparable cues (i.e. similar NPs) such as those involved in object relative clauses (e.g. Adani, 2011; Chen et al., 2005; Gordon et al., 2001; Just & Carpenter, 1992; King & Just 1991; Lewis & Vasishth 2005; Lewis et al., 2006; Miller & Isard, 1964; O'Grady, 1997; Riches et al., 2010; Traxler et al., 2002; Van Dyke & Lewis, 2003); non-canonical word order as seen with passive voice (e.g. Ferreira, 2003: Marinis, 2007; Stromswold, 2004); and irregular morphology such as irregular past tense morphology in English (e.g., de Zeeuw et al., 2013; Pinker, 1999; Pinker & Ullman, 2002).

There are contrasting findings as to whether cognitive complexity entails different processing strategies between populations. Children have been shown to reanalyse semantic and grammatical components of the passive only after the full sentence has been heard (i.e., offline) compared to adults who appear to use online morphological cues (e.g., Stromswold, 2004). However, it has also been shown that children and adults do not differ in how they process filler-gap dependencies (e.g., Clahsen & Felser, 2006). Instead, differences in processing between child and adult native speakers was due to differences in working memory capacity and reduced efficiency in retrieving lexical items.

The cognitive processing of language features may also be affected in terms of how frequent the language feature is in the input. Less frequent language features which include object relative clauses and passive voice may be more difficult to process compared to more frequent language features (e.g., Allen & Crago, 1996; Demuth et al, 1989; Demuth, 1990; Demuth et al., 2010; Gordon & Hendrick, 2005; Keenan 1975; Roland et al., 2007; Wells et al., 2009).

In terms of the cognitive complexity from a L2 perspective, adult L2 learners deviate from native speakers in that they are less sensitive to syntactic representations and thus engage in shallower processing (e.g., Clahsen and Felser, 2006). In contrast, child L2 speakers demonstrated the same processing strategies (using morphological cues to reanalyse and reassign thematic roles) as monolinguals (e.g., Marinis & Saddy, 2013). However, L2 processing of sentences may depend on the learner’s stage of development with L2 learners having to build up a range of linguistic processes before developing the capacity to use structures such as the passive or long-distance dependencies (e.g., Pienemann, 1998).

3.5 Summary of complexity in language

This chapter explored the concept of complex linguistic features and structures. While there is no overarching definition of complexity in language, it is often described from a structural (involving the formal or objective elements of a linguistic unit) or cognitive (involving the difficulty and cognitive cost in processing language) perspective.

Descriptions of structural linguistic complexity include subordination and interveners, non-canonical word order, and irregular morphological features (e.g., Anderson, 2015; Bowerman, 1979; Boyle et al, 2013; Bulté & Housen, 2012; Diessel, 2004; Givón, 1990; Lust et al, 2009; McWhorter, 2007; Norris & Ortega, 2009; Palotti, 2015). Specific examples of structurally complex linguistic features in English include object relative clauses, passive voice, and past tense morphology.

Cognitively complex language features include those which put a greater burden on processing capacity as shown through longer reaction times for accurate competency (van Gompel, 2013). This includes intervening constituents in long distance dependencies which have comparable cues with moved elements such as in object relative clauses (e.g., Lewis & Vasishth 2005; Lewis et al., 2006; Van Dyke & Lewis, 2003); non-canonical order of semantic and grammatical components such as passive voice (e.g., Ferreira, 2003; Marinis, 2007; Marinis & Saddy, 2013; Stromswold, 2004); and irregular morphology which may involve a whole-word processing method in which the lexical item is processed as an individual entry within the mental lexicon (e.g., de Zeeuw et al., 2013; Pinker, 1999; Pinker & Ullman, 2002).

In evaluating complexity from the participants' perspective (i.e., language processing in relation to children and non-native speakers), cognitive complexity is greater for both children and L2 language users who have been shown to exhibit slower processing of sentence structures (e.g., Clahsen and Felser, 2006; Marinis, 2007; Marinis & Saddy, 2013; Stromswold, 2004). This may be related to different processing strategies (e.g., Clahsen & Felser, 2006; Stromswold, 2004) or differences in L2 exposure and proficiency levels or cognitive limitations (e.g., Cunnings, 2016; Dekydtspotter et al., 2006; Hopp, 2006, 2010; Jackson & Bobb, 2009; Jackson & van Hell, 2011; Marinis & Saddy, 2013; McDonald, 2006).

In considering structurally and cognitively complex language, it is clear that there is an overlap between the two types in that in both cases, some of the same language features or structures are shown to be both structurally and cognitively complex. Examples include object relative clauses and passive voice. This may indicate that language features which are structurally complex entail higher processing demands for their accurate interpretation and are therefore also cognitively complex. It is beyond the scope of the current study to disentangle the effects of structural versus cognitive complexity however, predictions are made in section 3.7 regarding the impact of particular variables which are associated with cognition, and which may have more of an impact on processing cognitively complex features.

For the purposes of this study, a working definition of language complexity is described as language features which involve irregularity (e.g., past tense versus third person singular morphology), non-canonical word order (e.g., passive versus active voice), and intervening elements in long-distance dependencies (e.g., object versus subject relative clauses). The following section will present the target language features and the rationale for their inclusion as morphosyntactic outcome measures in the current study.

3.6 Target linguistic phenomena

The aim of the study is to investigate the impact of individual difference factors in sequential bilingual acquisition across measures which are complex and non-complex. In taking account of the preceding descriptions of complex forms identified in this chapter, the following language measures have been chosen as they comprise types of both complex and non-complex forms in English: active voice, passive voice, subject relative clauses, object relative clauses, third person singular morphology, and past tense morphology. Descriptions of each language measure in relation to complexity will be briefly outlined in the following list with examples where appropriate.

1. Third person singular in English (in comparison to past tense morphology which contains irregular forms) is a simpler (non-complex) language feature as it is a regular morphological form which has consistent morpho-phonological markers, and it can be processed via both a single and dual-system approach which may advantage its processing (e.g., de Zeeuw et al., 2013; Pinker, 1999; Pinker & Ullman, 2002).
   e.g., The dog eats the treat.

2. Past tense in English is a complex language feature as it contains both irregular ablaut or suppletive morphological forms and allomorphic representations of its regular -ed inflectional forms and therefore presents with inconsistent morpho-phonological markers (e.g., Anderson, 2015; McWhorter, 2007). In terms of irregular past tense forms, it may involve a whole-word processing approach only (as opposed to the dual-system approach for regular morphemes) in which the lexical item is processed as an

individual entry within the mental lexicon (e.g., Pinker, 1999; Pinker & Ullman, 2002). This may result in a disadvantage for the processing of irregular past tense forms (de Zeeuw et al., 2013).
Regular past: The cat climbed.
Irregular past: The cat ran.

3. Active voice can be defined as a simple (non-complex) structure as it involves canonical word order, no dependencies, and no intervening constituents. It is cognitively less complex in that language users do not demonstrate delays in processing this structure which is supported by data from online processing (e.g., Stromswold, 2004).
   e.g., The dog chased the cat.

4. Passive voice can be defined as a complex structure as it involves non-canonical word order which has been shown to be a structurally and cognitively complex linguistic feature (e.g., Ferreira, 2003; Fox & Grodzinsky, 1998; Hirsch & Wexler, 2006).
   e.g., The cat was chased by the dog.

5. Subject relative clauses contain a subordinate clause and are therefore often referred to as complex (e.g., Bowerman, 1979; Givón, 1990; Diessel, 2004; Lust et al, 2009; Norris & Ortega, 2009; Bulté & Housen, 2012; Boyle et al, 2013; Palotti, 2015). However, in comparison to object relative clauses they are structurally and cognitively less complex as they involve no intervening constituent.
   e.g., The dog that chased the cat.

6. Object relative clauses involving lexically restricted constituents can be defined as complex structures in that they comprise an intervening constituent in a long-distance dependency (e.g., Friedmann et al., 2009; Lewis & Vasishth 2005; Lewis et al., 2006; Van Dyke & Lewis, 2003).
   e.g., The cat that the dog chased.

3.7 Research questions

Bilinguals have been shown to be affected by a number of different individual difference factors which are both internal (e.g., age and cognitive effects) and external (e.g., environmental effects) to the individual. Previous research has mostly revealed mixed findings across domains in relation to the impact of these factors on the language proficiency of this population (e.g., Armon-Lotem et al., 2011; Bedore et al., 2016; Blom & Bosma, 2016; Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; De Cat, 2020; Jia and Fuse; 2007; Nishikawa, 2014; Paradis, 2011; Paradis et al., 2017; Paradis & Blom, 2016; Roesch & Chondrogianni, 2016; Rothman et al., 2018; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978; Unsworth, 2016). However, different types of target language features and factors have been measured across studies. The current study aims to investigate accuracy of the language measures presented above (3.6) and how they are impacted by the internal and external factors discussed in chapter 2.

It is expected that a number of individual difference factors will impact language measures depending on their level of complexity, with age and input measures likely to more strongly impact proficiency of those features which are complex (e.g., passive voice, object relative clauses, past tense morphology). It is not an aim of this study to investigate differences in acquisition or accuracy in relation to structural versus cognitive complexity. Nevertheless, the cognitive complexity of language focuses more on the processing of language. Therefore, it may be the case that predictor variables in the present study which are associated with cognition, such as age and memory, may be important factors in predicting the more cognitively complex target language features. In the current study, these include language structures such as passive voice, object relative clauses and irregular morphology.

In taking account of these issues, the first research question addressed in this thesis is: (1) How do internal and external factors affect proficiency of complex and non-complex language features in sequential bilingualism?

There may be interactions present between the individual difference factors, i.e., one individual difference factor may impact the relationship between the proficiency of the target language measure and another target factor. Therefore, our second research question is: (2) Are there interdependencies between predicting factors for the target language measures?

As shown in the discussion on complexity, there may be differences in how language measures are interpreted or used by L2 learners as opposed to monolinguals. Comparing these cohorts will bring further insights in relation to how differences in language populations interact with factors and linguistic complexity to impact language proficiency. Therefore, the final research question is: (3) Are there differences between the sequential bilingual and monolingual participant groups in terms of the impact of predicting factors on language measures ranging in complexity?[13]

[13] As not all factors are relevant for monolingual learners, this question will focus only on those that can be applied to both populations.

4. Methodology

4.1 Introduction

This thesis is a cross-sectional research study of 40 sequential bilingual and 40 monolingual children who were attending primary school in Northern Ireland. The bilingual participants were from immigrant and refugee backgrounds and spoke Arabic as an L1 at home and were acquiring English as an additional language. The testing was carried out over a seven-month period and data for the study came from a number of sources including both normed tests and a task designed specifically for the project. Each test was subsequently scored and then analysed using the R statistical programme (version 4.0) (R Core Team, 2017). This chapter will provide further information on the study participants (4.2), present the measures and tasks implemented in acquiring the data and how they were scored (4.3), and detail the procedures followed in data collection sessions (4.4). The data analysis used in the study will be presented in the results chapter.

4.2 Participants

As mentioned in the introduction (Section 1.2), the term sequential bilingual is used to describe the bilingual participants in the current study. This is due to a number of the participants falling outside of the boundaries for child second language acquisition in that they began meaningful (consistent and significant) exposure to English earlier than 3 years old. Nevertheless, all of the participants began acquisition of English sequentially (sometime after acquisition of the first language. Therefore, referring to the participants as sequential bilinguals is the more appropriate description in this context. Forty sequential bilingual children aged between 5;7 and 12;2 years old (mean 8;4) from L1 Arabic-speaking backgrounds were recruited for the study. As discussed previously, Northern Ireland has seen a steady increase in the numbers of sequential bilingual children (or newcomer pupils) attending mainstream schools over the last decade. Over 16,000 sequential bilinguals are currently enrolled in schools in Northern Ireland with the largest numbers in primary schools (Department of Education Northern Ireland, 2019).

When examining the impact of internal factors such as age on the linguistic proficiency of bilinguals, it is important to contrast outcomes with monolingual subjects so that it is known that any variances are an outcome of the actual targeted linguistic performance of the participants rather than any metalinguistic or test-taking abilities (Slavoff & Johnson, 1995). In addition, this study is interested in comparing differences in the proficiency of target measures between language populations. Therefore, the study recruited 40 age-matched monolingual English-speaking children aged between 5;3 and 10;6 years old (mean 8;5) to participate in the study. Monolingual children were age-matched on the basis that, as much as possible, similar numbers of children in each Primary year group were recruited for both the bilinguals and monolinguals. The difference in mean ages between the bilingual and monolingual children was one month. All parents of monolingual participants indicated that they spoke only English at home.[14][15]

Children were recruited from nine primary schools in and around Belfast, Northern Ireland. Each school involved in recruitment used English as the language of instruction and followed the Northern Ireland Curriculum (Foundation Stage to Key Stage 2). None of the children who participated in the study had a language impairment or learning disability as confirmed by their schools.

A total of 94 children (54 bilingual and 40 monolingual) were originally tested as part of the research project. Fourteen bilingual children were excluded from the study: one child did not pass the control measures; and for the others we were either unable to obtain the required language background information or children did not complete all required tasks and rescheduling further sessions was not possible.

While the majority of sequential bilingual children tested were foreign born (n=34), six participants were born in Northern Ireland. However, parents stated that

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[14] While all monolingual children spoke only English at home, two indicated that they attended a one-hour beginners' Spanish class per week during term time. In addition, on informally asking the children during testing if they spoke other languages, some (both bilingual and monolingual) reported that their schools scheduled one-hour per week Spanish or Mandarin classes as part of the curriculum during some school terms. While these classes will have exposed the participants to other language experiences, the limited exposure time is conceivably not likely to constitute sufficient input to have had any significant effect on their overall linguistic exposure. Significant exposure to language is normally associated with consistent immersive exposure (Paradis, 2011).

[15] While English is the predominant language in Northern Ireland, Irish Gaelic and Ulster Scots are recognised regional languages. There is an ever-increasing number of Irish Gaelic speaking children in Northern Ireland however, the vast majority of these speakers attend Irish medium primary schools where Irish is the language of instruction (Department of Education Northern Ireland, 2019). Ulster Scots is not as widely used and is typically spoken by older generations in small communities outside of Belfast. In relation to this study, none of the sequential bilingual or monolingual participants were reported to be Irish Gaelic or Ulster Scots speakers.

meaningful (significant and consistent) exposure (Paradis, n.d., 2011) to English did not begin immediately and ages of onset to L2 English for participants ranged from 5 months to 10 years (mean 4;3).[16] Length of exposure to English also ranged widely among the participants (7 months to 10;6 years, mean 4;1). Further information on participant demographics in relation to the bilingual children can be found in Table 4.1.

While some of the children were born in Northern Ireland, all parents of the bilingual participants were foreign born and from countries in which Arabic is the predominant language or one of the official languages of the country. Participants, or their parents, originated from thirteen different Arabic-speaking countries. The majority of bilingual participants (33) had Arabic solely as their first language. The remaining seven children were trilingual speakers who were exposed to two languages in the home environment. Two trilingual children were Arabic/French speakers, three were Arabic/Kurdish speakers, and two were Arabic/Somalian speakers. Further information pertaining to the participants' country or origin and the languages they know is detailed in Appendix (A).[17]

Table 4.1 Demographic information of the sequential bilingual participants

Factor	Mean	SD	Range/Description
Chronological age	8;4 (101 months)	1;9 (23 months)	5;7 – 12;2 (69 – 147 months)

[16] As indicated in the literature review, some definitions of sequential bilingualism in childhood specify a lower boundary of 3 or 4 years old and an upper boundary of 7or 8 years old in terms of age of L2 onset. In the case of the current study, we took sequential bilingualism in childhood to refer to children who had begun learning the additional language sequentially at any age before adolescence.

[17] Due to the different countries of origin, it should be noted that it may be the case that the bilingual participants had exposure to Arabic with dialectal variations. In addition, the children may or may not have had exposure to, or be recently exposed to, Modern Standard Arabic either through schooling in their home country or through Arabic school/classes in Northern Ireland. Analysis of the impact on L2 proficiency of different variations of Arabic or of trilingualism versus bilingualism, is beyond the scope of the present study. However, it is conceivable that different linguistic features or typology may have a bearing on results. Therefore, this will be considered in the discussion section in light of the study's findings.

Age of onset of L2 acquisition	4;3 (51 months)	2;4 (29 months)	0;5 – 10;0 (0.5 – 120 months)
Length of exposure	4;1 (49 months)	2;2 (27 months)	0;7 – 10;6 (0.7 – 128 months)

4.3 Measures and instruments used to gather data

As outlined in the literature review, several different internal and external individual difference factors (e.g., age, memory, motivation, input, etc.) impact the proficiency of sequential bilingual language acquisition (e.g., Armon-Lotem et al., 2011; Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; De Cat, 2020; Jia and Fuse, 2007; Paradis, 2011; Paradis & Blom, 2016; Paradis et al., 2017; Sorenson Duncan & Paradis, 2018; Ushioda & Dornyei, 2012; Unsworth, 2016). The inclusion of a diverse range of measures allowed the opportunity of observing which types of factors, from a high number of possibilities, impacted the participants' language development. The data were gathered and analysed for this research by a native English speaker (myself). Testing linguistic ability included normed tests of expressive vocabulary, morphology, and narrative structures; and an experimental task developed specifically for the project which evaluated receptive understanding of sentence structures which were complex and non-complex (actives, passives, and subject and object relative clauses). A parent questionnaire adapted from the Alberta Language Environment Questionnaire (ALEQ: Paradis, n.d, 2011) was used to measure a number of internal, and quantitative and qualitative factors influencing L2 exposure and input. Memory was tested by administering a normed test of phonological short-term memory (Comprehensive Test of Phonological Processing, CTOPP; Wagner, Torgesen & Rashotte, 1999) and a teacher questionnaire (Appendix E) developed specifically for the study, was used to rate the child's L2 English use at school and their motivation for learning L2 English. The following sections detail each of the measures employed in the study.

4.3.1 Lexical proficiency

Children's lexical knowledge is a crucial feature of linguistic competency and forms the basic foundations of language learning which drive the acquisition of larger units like sentence structures (Dickinson & Tabors, 2006; Read, 2000; Treffers-Daller, 2013). Due to its impact on other areas of language learning, which include the target sentence structures in the present study, it is important to understand further and thus measure the breadth of the participants' lexical knowledge. Moreover, previous research demonstrates that various individual difference factors impact knowledge and use of vocabulary in sequential bilingual acquisition. This includes an older age (e.g., Blom & Bosma, 2016; Golberg et al., 2008; Paradis, 2011; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978) higher working memory skills (e.g., De Cat, 2020; Engel de Abreu et al., 2011; Thorn & Gathercole, 1999; Verhagen & Leseman, 2016), greater current and cumulative exposure to the second language (De Cat, 2020; Sorenson Duncan & Paradis, 2018; Unsworth, 2016), higher socio-economic status (e.g., Oller & Eilers, 2002) and greater maternal L2 proficiency (e.g., Chondrogianni & Marinis, 2011).

The assessment used to test lexical proficiency in the current study was the Word Finding Vocabulary Test (The Renfrew Language Scales; Renfrew, 1995). This is a standardised test evaluating children's expressive vocabulary skills. This assessment employs a discrete, convergent, picture naming method, which is a common instrument type used in evaluating children's lexical naming ability and involves testing responses to a sample of words which occur within a specific frequency range (Nippold, 2007; Read, 2007). The Word Finding Vocabulary Test comprises 50 line-drawn pictures of objects (nouns) arranged in order of difficulty. The pictures are shown to the participant one by one, and they are asked to name each item and responses are scored. The discrete approach employed by this assessment is selective and measures the individual's knowledge of specific word meanings as independent constructs separate from other features of language competence and without contextual information (Read, 2000). Participants were scored either correct (1) or incorrect (0) for each of the 50 lexical items tested. Approximations of the word where they child expressed only part of a word to describe it (e.g., 'ma' for 'map' or 'para' for 'parachute') were not scored as correct. Where the child used a similar word or the North American-English version for describing the item, they were scored as correct, e.g., ‘bat’ for ‘racket’, ‘wrench’ for ‘spanner’, ‘spire’ for ‘steeple’. Each trial was entered into the dataset individually.

4.3.2 Morphology

The task to assess morphology in the present study was the Test of Early Grammatical Impairment (TEGI, Rice & Wexler, 2001). The current study included the TEGI Screening Test which examines use of third person singular and regular and irregular past tense morphology in English. The TEGI is a standardised test of morphosyntactic competency which has been used frequently in studies on sequential bilingual acquisition (e.g., Blom & Paradis., 2015; Chondrogianni & Marinis, 2011; Paradis, 2011; Paradis & Blom, 2016). This assessment comprises picture elicitation probes requiring subjects to produce sentences in English using words with target morphological features.

The TEGI is an example of a criterion-referenced tool which elicits specific target morphological items which allows greater comparability across participants compared to language sampling. It also comprises a high number of target items: the TEGI screening test includes ten elicitation sentences for third person singular, and eighteen for past tense (10 regular verbs and 8 irregular verbs). This can offer a more thorough evaluation of morphological proficiency in comparison to norm-referenced tests which are often used to identify overall language deficits and therefore contain a limited number of items for evaluating particular structures (Oetting & Hadley, 2017). The TEGI also includes a phonological probe which evaluates the subjects’ ability in producing specific phonemes which can capture the underlying knowledge of these features. For instance, if the subject passes the phonological probe successfully (i.e., they are shown to be able to produce the phonemes involved in the target morphemes) but does not realise the form in the morphological probe, then it can be presumed that the difficulty is related to deficits in their knowledge of inflectional morphology rather than in realising surface phonological features (Grondin and White, 1996; Haznedar, 2001; Haznedar & Schwartz, 1997; Ionin and Wexler, 2002; Lardiere, 1999, Prévost and White. 2000; White, 2003). In addition, while other methods for assessing morphological proficiency, such as calculating the Mean Length of Utterance (MLU) in language sampling, can be time-consuming (e.g., obtaining sufficient language samples, transcribing, coding and analysing the data), the TEGI is easy to set up, administer and score. The colourful pictorial representations of items through its digital format are also age-appropriate and engaging for child participants. Finally, as the TEGI is a commonly used evaluation of morphological proficiency in language acquisition research (e.g., Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; Paradis & Blom, 2016) its use can provide comparability across studies.

Three probes are included in the TEGI screening test: the phonological probe, the third person singular probe and the past tense probe.

The phonological probe establishes whether the subject is capable of producing or marking the word-final phonemes of the target English morphology. This includes the phonemes /-s/ /-z/ which are used to evaluate production of third person singular morphology in the third person singular probe, and /-t/ and /-d/ which are used to test regular past tense in the past tense probe. Children are shown 20 pictures of different items one by one and asked to name them. Each item contains a target word-final consonant/phoneme, and each phoneme is tested 5 times. If the child offers a response to the item which does not comprise the target word final phoneme (e.g., ‘home’ instead of ‘house’), examiners are required to provide a model which the child is encouraged to reproduce. To pass the phonological probe, the subject must be able to produce 4 out of the 5 items of each phoneme group tested. Every participant in the present study was able to produce all target phonemes.

The third person singular probe evaluates the participants’ use of /-s/ or /-z/ on present tense verbs. This probe includes a practice item followed by 10 test items. Each item shows a picture of a person who has a specific occupation (e.g., a teacher) and who is carrying out their job in the picture. The participant is provided with a prompt which states what the occupation is and is then asked to say what each person does. For example, the practice item shows a teacher teaching in a classroom. The prompt involves telling the child ‘Here is a teacher. Tell me what a teacher does.’ The targeted response would be ‘A teacher teaches.’

The past tense probe evaluates the subject’s use of both regular (/-d/ or /-t/ final word phonemes) and irregular past tense forms of verbs. This probe comprises two practice items followed by 18 test items, 10 of which are target regular past tense forms and 8 irregular forms randomised throughout the set. Each item presents two pictures showing the same character but in two different scenarios. In the first scenario, the character is doing an action while in the second picture the character has completed the action. The participant is prompted to look at the first picture and is told what action the character is doing (e.g., 'Here, the girl jumps in the puddle.'). Then the participant is prompted to look at the second picture and told the character has completed the action (e.g., 'Now she is done. Tell me what she did'.) The targeted response would be 'She jumped in the puddle.' The participant is given time to provide their response which is recorded and scored. Participants were scored either correct (1) or incorrect (0) for each of the 28 morphological (third person singular and past tense) items tested.

4.3.3 Syntactic measures

To measure comprehension of target sentence structures (active voice, passive voice, subject relative clauses, object relative clauses) we used The Coloring Book Task (Pinto & Zuckerman, 2018). This task is a digital colouring paradigm completed on a touchscreen PC which assesses participants' interpretation of target structures by way of colouring in characters in the context according to the sentence they hear (Gerard, 2016; Pinto & Zuckerman, 2018; Zuckerman et al., 2016). Participants were shown a black and white image on a touchscreen laptop consisting of three animal characters performing the same action on each other (Figure 4.1).

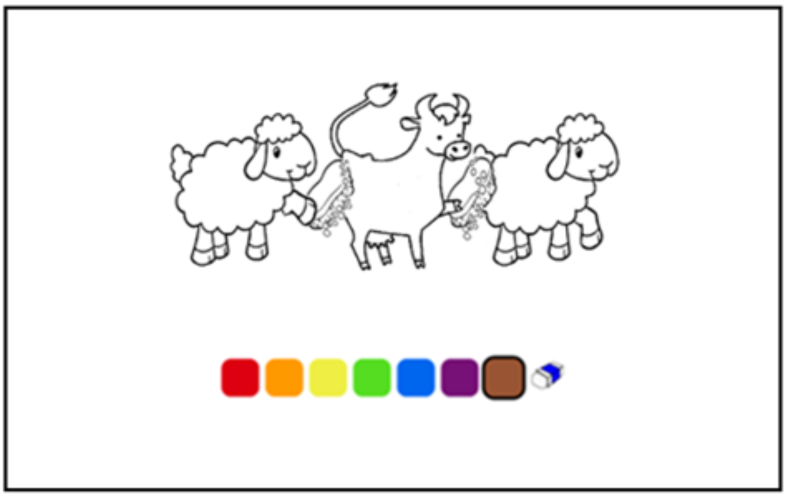

Figure 4. 1 Sample item from colouring task

In the sentence stimuli, one character is the agent (doing the action), and one is the patient (receiving the action). Children reveal their grammatical interpretations by colouring one character (choosing from an array of coloured squares below the characters) according to the sentence heard.

The interactive format of the instrument encourages engagement throughout the task. In addition, the animal characters and colours incorporated into the task and game-like feel should foster children's attention to the task. The type of experimental design chosen for the current study, which involves one picture per sentence, attempts to reduce cognitive costs and processing load compared to multiple picture selection tasks which require participants to hold a sentence in mind while processing actions in several different pictures (Frizelle et al., 2017; Marinis, 2010). The simpler experimental design attempts to reduce any task effects to allow us to tap into children's comprehension without the confounds of a complex task.

As discussed in chapter 3, complex sentence structures can involve non-canonical word order (e.g., passive voice), and intervening elements in a long-distance dependency (e.g., object relative clauses) (e.g., Ferreira, 2003; Fox & Grodzinsky, 1998; Friedmann et al., 2009; Hirsch & Wexler, 2006; Lewis et al., 2006; Lewis & Vasishth 2005; Van Dyke & Lewis, 2003). In contrast, less complex structures can comprise canonical word order and no intervening elements (e.g., active voice, subject relative clauses) (e.g., Friedmann et al., 2009; Stromswold, 2004). Therefore, sentence structures targeted in the present study for the colouring task included interpretation of active and passive voice and subject and object relative clause sentences.

The current task comprised a randomised sentence design including all target sentence structures (active voice, passive voice, subject relative clauses, object relative clauses) with eight sentences included for each type. Test items were alternated with fillers comprising simple present tense sentences with an inanimate argument (Table 4.2; 5). Each sentence included a preamble describing the animal characters and requesting the participant to choose a colour, e.g., "Ok, so in this picture there's a sheep, a cow, and another sheep. Let's choose a colour now". Examples of each sentence type are shown in Table 4.2 and the full scripts are presented in Appendix (B). Figure 4.1 illustrates the picture that accompanied the sample target sentences in Table 4.2.

The verbs chosen for the sentence structures were either transitive verbs which require an object (e.g., The dog washed the sheep), or optional intransitive verbs (e.g., The cat painted the frog) which may or may not take an object, but which, through rich contextual cues, indicated to participants that an object was required. The verbs used in the task were: chase, wash, pull, cover, paint, kiss, comb, bury, spray, brush, kick, follow, fan, carry, bite, and catch.

Table 4.2 Sample sentences from the colouring task

	Condition	Example
1.	Active voice	Ok, so in this picture there's a sheep, a cow, and another sheep. Let's choose a colour now. The cow washed the blue sheep.
2.	Passive voice	Ok, so in this picture there's a sheep, a cow, and another sheep. Let's choose a colour now. The cow was washed by the yellow sheep.
3.	Subject relative clause	Ok, so in this picture there's a cow, a sheep and another cow. Something here is blue. It's the sheep that washed the cow.
4.	Object relative clause	Ok, so in this picture there's a cow, a sheep and another cow. Something here is yellow. It's the sheep that the cow washed.
5.	Filler	Ok, so in this picture there's a donkey, a dolphin, and a kangaroo. Something here is pink. It drives a bus.

The fillers also acted as control sentences. If participants did not respond at ceiling (75% correct) for controls, their data were excluded from the analysis. As mentioned previously, only one participant was excluded for not passing controls. Each participant's colouring task was video recorded so that screenshots of answers could be checked and scored.

The procedure used for the colouring task started with training items which were included so that participants could become accustomed to the process of colouring using the touchscreen laptop. The pictures had an array of coloured squares below each image, and participants were directed to choose a colour by tapping a square and then tapping one of the characters in the image. There were three training items which incrementally increased in complexity (Appendix B). The first training item presented participants with 2 inanimate objects (two pieces of fruit) and the subject was first instructed to choose a colour from the array of coloured squares below the image and was then given a sentence and then requested to colour one item in the picture (e.g., 'Choose a colour for this picture. In this picture there is a strawberry and some grapes. Colour the strawberry <chosen colour>'). The second training item image consisted of three inanimate objects and the same instruction type was given. The third and final training item consisted of three animate items holding inanimate objects. The sentence structures included in the training items did not reflect the target sentence structures. All participants were able to colour the target items during the training session.

The main test items consisted of stimuli comprising 32 trials for the target sentence structures (8 per sentence structure: active voice, passive voice, subject relative clauses, object relative clauses) for the colouring task. Children were randomly assigned either list 1 or 2: list 1 began with the active/passive voice set followed by the subject/object relative clause set; and list 2 began with the subject/object relative clause set and was followed by the active/passive voice set (Appendix B). Participants were scored either correct (1) or incorrect (0) for each of the 32 target sentence structures tested. As with all language measures, each trial was entered into the dataset individually. Details on how the results were statistically analysed is presented in the following chapter.

In terms of measuring expressive syntax, the current study used the Edmonton Narrative Norms Instrument (ENNI, Schneider et al., 2005) to evaluate the participants' production of syntax and mean length of utterance. The ENNI is a picture elicitation story task which can be used to measure a range of linguistic abilities including lexical, morphological and syntactic skills. Previous research has used this task to measure bilingual children's use of story-grammar elements, referring expressions (e.g., Paradis & Kirova, 2014; Sorenson Duncan, 2017), and dependent clauses (Paradis et al., 2017; Paradis & Kirova, 2014; Sorenson Duncan, 2017). In the present study, the ENNI was used to measure production of a range of sentence structures including subordinate clauses (relative, adverbial, appositive, and wh- clauses, direct and indirect quotations, and sentences serving as noun phrases) and non-finite clauses (infinitive, unmarked infinitive, wh- infinitive, gerund, and past participles). Examining production of grammatical forms alongside the main experimental comprehension task, provided the opportunity to collect and analyse sentence structures using more naturalistic, and therefore, richer, language samples which could ultimately provide further and deeper understanding of participants' use of syntax. According to Schneider et al. (2006), using narrative tasks involve types of expression which are more frequently found in natural everyday life and which require participants to use word combinations and sentences, as opposed to specific words or sentences used in isolation (and which are commonly evaluated by experimental language research tasks) and is therefore a more ecologically valid measure of syntax.

The ENNI comprises six story books which contain a series of wordless pictures (Paradis et al, 2017; Schneider et al., 2005). Narrative storytelling involves a number of elements for the coherent organisation of the story comprising both macrostructural and microstructural elements. The macrostructural organisation refers to the arrangement of the story (Peterson & McCabe, 1991; Stein & Glenn, 1979; Van Dijk, 1976). These types of stories are typically based on the Story Grammar model in which a central character is compelled to achieve a goal-directed action with the story focused on the character's attempts to realise that goal (Stein & Glenn, 1979) (see Pesco & Kay-Raining Bird, 2016, for further information on the Story Grammar Model used in narrative tasks). However, in the present study we focused on the microstructural elements of the story which involved the participants' use of morphosyntactic units and phrases, specifically, subordinate and non-finite clauses.

From the six story books available through ENNI, we selected story book A2 to be used in the testing sessions. The pictures from this story book are presented in Appendix C. Preceding the main narrative task, participants completed a training story—a very short story-telling task—to facilitate their understanding for the main narrative task. Each picture of the training and main stories was printed and placed into individual plastic sleeves. Each story was then ordered and put into ring-bound folders. To complete the tasks the participants were first instructed to only look at each picture one by one as the instructor turned each page. The children were given a few seconds to view each picture before moving on to the next one. Once the pictures were viewed, they were then presented to the children again who were told that the examiner could not see the pictures and asked to tell the story to the instructor.

Each participant produced a recorded language sample based on the picture story. A number of the language samples were rather limited in terms of the utterances produced; an observation also noted in Paradis et al (2017). This will be considered further in the discussion chapter. Recordings were transcribed in basic sentence form and analysed as per the complexity index provided in the ENNI manual instructions. The complexity index views a complex sentence as those which contain an independent or main clause and one or more dependent clauses. Dependent clauses are parts of sentences which contain verbs in subordinate or non-finite (embedded) forms as per the examples presented in Table 4.3.

Table 4.3 ENNI – Examples of embedded clause sentences

	Complex sentence type	Example
1.	Relative clause	The lifeguard used the net that was by the pool.
2.	Adverbial clause	He was angry because she had dropped it.
3.	Direct and indirect quotations	He said, “Thank you”.

4. Infinite clauses — He wanted to get the plane.

5. Wh- clause — That's how it happened.

6. Gerund clause — She made a mistake trying that.

(Examples taken from the ENNI complexity Index; Schneider et al., 2005)

Table 4.4 Sample scoring of subordinate and non-finite clauses in narrative production

Utterances from the speech sample of participant number 16 (monolingual participant) with embedded clauses underlined	Number of embedded clauses in each utterance
So the giraffe is called Geoff and he has his airplane and he's going <u>to play</u> with it in the pool but then Ellie the elephant says <u>that she wants to play</u> and <u>he says 'no'</u>.	3
And he <u>starts playing with it</u> and <u>she gets sad because she feels left out</u>.	2
And then she steals it off him and he yells at her.	0
But she drops it in the pool and he's cross	0
So he starts <u>to shout</u> at her and <u>she's sad because she doesn't like being shouted at</u>.	2
So then the lifeguard comes and <u>he's asking what happened</u> and <u>Geoff said that she took his plane and put it in the water</u>.	2

So then she starts to say that she didn't mean to but he doesn't believe her.	1
So then he decides that he'll try and get it but he doesn't want to get wet so he doesn't jump in and he just tries to reach it but he can't.	2
So she's a bit sad because she was thinking 'oh dear, it's not mine and I've lost it'. And then the giraffe starts to cry because he's sad.	2
So she finds a fishing net and says that she's going to fish it out for him.	1
But it's quite hard so she keeps going until she gets it.	0
Then she gets it and gives it back to him and he's happy.	0
And then they become friends and he lets her play with it as long as she doesn't drop it in the water.	0

To calculate the score for embedded clauses in narrative production, all the independent and dependent clauses in the transcript were totalled and then divided by the number of independent clauses. E.g.: In the speech sample above with 13 independent clauses, there are 15 embedded clauses in the sample, therefore the calculation would be:

$$13 + 15 / 13 = 2.15$$

Mean length of utterance (MLU) in the narrative storytelling task was calculated by averaging the number of morphemes per utterance used. This was completed by using the 'MLU morphemes' count via the 'kideval' command in CLAN.

4.3.4 Age and environmental input factors

The present study used a parent questionnaire (Appendix D) adapted from the Alberta Language Environment Questionnaire (ALEQ, Paradis, n.d.) to measure the following age and environmental input factors:

- chronological age
- age of L2 onset
- length of L2 exposure
- L2 language use at home
- richness of the L2 environment
- socio-economic status (as measured through maternal education)
- maternal L2 proficiency.

Chronological age was the child's age at time of testing. Age of L2 onset indicated the age at which the participants began meaningful (consistent and significant) exposure to English. Length of L2 exposure was a measure of overall meaningful (consistent and significant) exposure to English. External factors can consist of quantitative and qualitative aspects of proximal linguistic input such as L2 language use at home, and richness of the L2 environment, while distal environmental factors impacting the context within which input occurs, include socio-economic background (often measured by way of maternal education), and maternal L2 proficiency. As stated in chapter 2, these types of factors are commonly measured through parent interviews or questionnaires in which parents provide information on theirs' and the child's language background and rate the child's language exposure and use in different situations. Parental interviews and questionnaires uniquely allow researchers to obtain information on the complexities of the environmental factors which impact bilingual children which could not be otherwise captured (Paradis et al., 2017; Sorenson Duncan, 2017).

While parent questionnaires are often administered through a spoken interview between the parent and the researcher, and often with the aid of an interpreter/cultural broker (e.g., Paradis, 2011; Sorenson Duncan, 2017; Unsworth, 2013; Unsworth et al., 2014), this was not feasible for the present project. Therefore, the parent questionnaire was translated to Modern Standard Arabic (by a native speaker of Arabic) and given to the participants' mothers to complete. Factors were measured by asking the mothers to rate each environmental aspect as follows:

- L2 language use at home by each household member (including all adults and siblings present at home, if applicable) to the child, and from the child to each household member, by choosing a score from a 5-point rating scale (1 = Mother tongue always/English never, 2 = Mother tongue usually/English seldom, 3 = Mother tongue 50%/English 50%, 4 = Mother tongue seldom/English usually, 5 = Mother tongue almost never/English almost always). The overall score for L2 language use at home was calculated as per the ALEQ parent questionnaire (Paradis, n.d.; Paradis, 2011). This was completed by totalling each score for the relevant questions/rating scales and dividing by the number of scores to get a proportional score (See Appendix D for further information and an example).

- Richness of the L2 environment by indicating how often the child engages in social/extracurricular activities with the L2 as the language of instruction (0 = Almost never/Never, 1 = At least once a week, 2 = Everyday), and rate the language spoken between the child and the friends they regularly play with, using a 5-point rating scale (1 = Mother tongue always/English never, 2 = Mother tongue usually/English seldom, 3 = Mother tongue 50%/English 50%, 4 = Mother tongue seldom/English usually, 5 = Mother tongue almost never/English almost always). The overall score for richness of the L2 environment was calculated as per the ALEQ parent questionnaire (Paradis, n.d.; Paradis, 2011). However, there are differences between the current study and the ALEQ questionnaire in terms of the specific activities used to measure this factor. The ALEQ questionnaire measures richness of the L2 environment in terms of a number of interactions (with literacy, computer use, TV and films, storytelling, songs, extracurricular activities and play with friends). As above, in the current study, the measure of richness of the L2 environment involves a measurement of 2 of these features only: social/extracurricular activities with the L2 as the language of instruction and L2 English use during play with friends. As per the ALEQ questionnaire, the richness of the L2 environment score was calculated by totalling each score for these questions and dividing by a fraction to get a proportional score (See Appendix D for further information and an example).

- Maternal education by indicating the highest qualification obtained using a 6-point rating scale (1 = Primary education, 2 = Secondary education, 3 = Higher Educational Institution, 4 = Undergraduate degree, 5 = Masters, 6 = PhD).

- Maternal L2 proficiency by asking the mothers to rate their fluency in English using a 5-point rating scale (1 = No understanding/ speaking ability, 2 = Some understanding and can say short, simple sentences, 3 = Good understanding and can express myself on many topics, 4 = Can understand and use English adequately for work and most other situations, 5 = Can understand almost everything/very comfortable expressing myself in English in all situations) (Logue et al., 2020).

In addition, a teacher questionnaire developed specifically for the study (Appendix E) was used to measure L2 English use at school. Although the previous studies reviewed in chapter 2 have not included a teacher questionnaire to capture input effects at school, asking teachers to report on this is an appropriate method in establishing this information as the child's teacher would have direct knowledge of their use of the L2 in this context. L2 English use at school was evaluated by the child's main primary school teacher rating their percentage use of English in the school environment.

4.3.5 Motivation for learning the L2

The teacher questionnaire was also used to measure the child's motivation for learning English (Appendix E). As detailed in chapter 2, motivation is described as an individual's choice of action, their perseverance with the activity, and the amount of exertion applied in doing the action (Dörnyei, 1998). It is considered a significant cause of individual variation in outcomes of adult L2 proficiency (e.g., Dörnyei, 1998; Ushioda & Dornyei, 2012). Specifically, integrative motivation (i.e., the impetus to integrate with the target language culture) has also been linked to greater L2 proficiency (e.g., Gardner & Lambert, 1972; Herschensohn, 2007). However, as motivation is a multifaceted construct which can be influenced by many internal, contextual and temporal procedures, it is difficult to measure objectively (Ushioda & Dornyei, 2012). Tasks in measuring motivation have involved participants completing self-reports which ask them to rate their perspectives on learning the L2 (Dörnyei, 1998). However, due to the ages of study participants and the variation in their L2 proficiency, self-reporting of motivation to learn the L2 was not an appropriate measure. Other measurement types include interviewing teachers and observing classroom interactions (Shoaib & Dornyei, 2005; Wei, 2016). However, this was not feasible in relation to the present study. Therefore, in place of this, a teacher rating of this factor was used. This measure involved the participant's main school teacher rating the participant's motivation for learning English on a scale of 1 to 5 (1=low ability and 5 = high ability) (Appendix E). The rating was then converted to a percentage score.

4.3.6 Short-term memory

Participants' short-term memory skills were tested with the nonword repetition task from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen & Rashotte, 1999). As mentioned in chapters 2 and 3, memory skills have been shown to be predictive of linguistic proficiency (e.g., Hart & Harley, 1997; Gathercole, 2006; Masoura & Gathercole, 1999; Paradis, 2011; Paradis et al., 2016; Paradis et al., 2017; Verhagen & Leseman, 2016; De Cat, 2020). Short-term memory has been measured most commonly using either the digit span test or a nonword repetition task. Previous studies have used non-word repetition to predict the English ability of child L2 learners (e.g., Service, 1992; Masoura & Gathercole, 2005) which have shown that performance on this task was highly correlated with vocabulary ability. Using this task will also ensure comparability with other similar studies which have included non-word tasks as measures of short-term memory with child L2 participants (e.g., Paradis, 2011; Paradis et al., 2017).

This task measures the phonological short-term memory component (the ability to temporarily store phonological information from the environment in mind) of working memory through repetition of nonwords (i.e., made up words). Eighteen nonwords are tested which gradually increase in syllable length and thus difficulty throughout the assessment. The items, which the test provides pre-recorded, were downloaded onto a PC and played to the child via a PC audio player. The child was asked to repeat each one directly after listening to it. Their repetitions were recorded and later scored according to the tester's manual. The children scored either correct (1) for the accurate repetition of each nonword, or incorrect (0) for the inaccurate repetition of each nonword. The raw score was calculated by totalling the number of correct repetitions given. This was then divided by the total number of test items (18) to give a percentage score.

4.4 Data collection procedures for testing sessions

Data collection began in May 2018 and ended in March 2019, and testing was administered over seven months (May, June, October, November and December 2018; and February and March 2019). Sessions at each school generally took place over a number of weeks but this varied and depended on the availability of adequate space at the school. Individual sessions normally took between 25 to 30 minutes to complete. If any child indicated or showed tiredness the session was stopped so they could take a break before being ready to start again. Most participants took part in one block session, but a small number required a break and in a few cases the timing of morning recess or lunch meant that the session was broken into two sessions. The vast majority of sessions were completed on the same day however, a few had to be completed over two days due to the timing of some sessions extending near to the end of the school day.

Days and times of sessions were arranged in collaboration with the schools and all sessions took place within school hours. Data were collected from participants individually in a quiet room in the school. The participant was introduced to the researcher by a school representative and given an overview of what was involved in the session and asked whether they wished to take part. Once verbal assent was given, the tasks were presented as game-like activities so that the children would feel more relaxed in the sessions, and this would encourage fuller engagement with the activities and therefore more productive sessions (Rocca, 2007). A laptop was used to administer most of the visual and auditory task materials and sessions were video recorded. Scoring did not generally take place during sessions so as not to influence answers or make the child nervous. However, at times it was necessary to take some notes during the session so that relevant or important information regarding participant answers could be highlighted later when scoring.

4.5 Summary

In summary, tasks used in the study were: the Word Finding Vocabulary Test (Renfrew, 1995) for measuring expressive lexical proficiency; the TEGI (Rice & Wexler, 2001) for measuring use of third person singular and past tense morphology; the Coloring Book task (Pinto & Zuckerman, 2018) for measuring comprehension of active and passive voice, and subject and object relative clauses; the CTOPP (Wagner, Torgesen & Rashotte, 1999) to measure working memory; and a language environment questionnaire (adapted from the ALEQ; Paradis, n.d) to measure chronological age, age of L2 onset, L2 language use at home, socio-economic status (as measured through maternal education), maternal L2 proficiency, richness of the L2 environment; and a teacher questionnaire to measure L2 English use at school, and motivation for learning the L2.

The following chapter will present the descriptive statistics, statistical analysis, and results of the present study.

5. Results

5.1 Introduction

This research project aimed to evaluate the impact of internal and external individual difference factors in predicting accuracy of linguistic measures which were complex and non-complex in sequential bilingual acquisition using linear mixed effects modelling. As discussed in the literature review, research in the domain of sequential bilingual acquisition reveals mixed findings for the impact of a number of individual difference factors on the linguistic development of this population.

The study's dependent variable was accuracy on target linguistic measures including expressive lexical range, use of third person singular and past tense morphology, and interpretation of active and passive voice and subject and object relative clauses. For expressive morphosyntax, the dependent variable was mean length of utterance and use of embedded clauses in narrative production. Independent continuous variables comprised a range of internal and external factors including chronological age, age of first meaningful exposure to the L2, short-term memory capacity, motivation for learning the L2, length of L2 exposure, L2 English language use at home, richness of the L2 environment, L2 English language use at school, maternal education (socioeconomic status), and maternal L2 proficiency.[18]

The chapter is structured as follows: first, the descriptive statistics for both the bilingual and monolingual participants are presented (5.2) followed by the statistical analysis used in the study (5.3). Subsequently, previous research and predictions are reviewed before presenting the results from the linear regression analyses for the bilingual (5.4) and monolingual (5.5) participants. The bilingual and monolingual results are then contrasted (5.6), and the final section provides a summary of the chapter (5.7).[19]

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[18] The measure of short-term memory included in the present study was specifically phonological short-term memory, a component part of working memory (e.g., Baddeley, 2003; Papagno et al., 2007).

[19] Statistically significant differences between the two language groups (bilinguals and monolinguals) in terms of accuracy of linguistic measures and/or the impact of non-linguistic measures was not tested.

5.2 Descriptive statistics

This section describes the general results in terms of mean scores and ranges of the bilingual and monolingual participants. Mean, standard deviation (SD), range and descriptions of scores for each predictor are reported in Table 5.1 for the bilingual participants and Table 5.2 for the monolingual participants. Mean scores of each linguistic measure are presented in Figures 5.1-5.2 for both the bilinguals and monolinguals. The following sections present the descriptive statistics for the linguistic measures followed by the non-linguistic measures.

Table 5.1 Summary of mean, SD, ranges, and descriptions of scores for factors in relation to the sequential bilingual participants

Factor	Mean	SD	Range/Description
Chronological age	8;4 (100 months)	1;9 (23 months)	5;7 – 12;2 (69 – 147 months)
Age of first meaningful exposure to the L2	4;3 (51 months)	2;4 (29 months)	0;5 – 10;0 (0.5 – 120 months)
Motivation for learning the L2	4.39	1.08	1.00 – 5.00 (scale= 1-5; 1=low ability & 5 = high ability)
Short-term memory	.68	.10	.44 - .94 (scale = 0-1; % accurate repetition of each nonword)
Length of L2 exposure	4;2 years	2;3 years	0;7 – 10;7 (0.7 – 128 months)

	(49.8 months)	(27.4 months)	
L2 language use at home (to/from child)	.45	.28	.00 – 1.00 (scale = 0-1; 1 = Mother tongue always/ English never, 2 = Mother tongue usually/ English seldom, 3 = Mother tongue 50%/ English 50%, 4 = Mother tongue seldom/ English usually, 5 =Mother tongue almost never/ English almost always)
Richness of L2 environment	.76	.17	.29 – 1.00 (scale = 0-1; proportional score of combined measures: L2 social/extracurricular activities (0 = Almost never/Never, 1 = At least once a week, 2 = Everyday), language spoken in L2 play (1 = Mother tongue always/English never, 2 = Mother tongue usually/English seldom, 3 = Mother tongue 50%/English 50%, 4 = Mother tongue seldom/English usually, 5 = Mother tongue almost never/English almost always)
L2 language use at school	.95	.17	.05 – 1.00 (scale = 0-1; % use of English at school)
Maternal education	3.80	1.45	1.0 – 6.0 (scale = 1- 6; 1 = Primary education, 2 = Secondary education, 3 = Higher

			Educational Institution, 4 = Undergraduate degree, 5 = Masters, 6 = PhD)
Maternal L2 proficiency	3.70	1.33	1.0 – 5.0 (scale = 1-5; 1 = No understanding/ speaking ability, 2 = Some understanding and can say short, simple sentences, 3 = Good understanding and can express myself on many topics, 4 = Can understand and use English adequately for work and most other situations, 5 = Can understand almost everything/very comfortable expressing myself in English in all situations)

L2 = second language

Table 5.2 Summary of mean, SD, ranges, and descriptions of scores in relation to the monolingual participants

Factor	Mean	SD	Range/Description
Chronological age	8;5 (101 months)	1;6 (19.3 months)	5;3 – 10;6 (64 – 128 months)
Short-term memory	.74	.11	.50 – 1.00 (scale = 0-1; % accurate repetition of each nonword)

5.2.1 Linguistic measures

Mean scores for linguistic measures are shown in Figures 5.1-5.2. The mean score for expressive lexical range for the bilingual participants was low with a wide range of scores (.18-.86) while monolinguals demonstrated a high average mean score and smaller range (.62-.98). For target morphological features (third person singular and past tense in the TEGI task), mean scores were generally high for the bilingual participants with the majority (more than two thirds) scoring above .70, however, results ranged widely (third person singular: .00-1.00; past tense: .06-1.00). Monolingual participants demonstrated high mean scores for both target morphemes which presented with very narrow ranges in scores with all but one participant scoring .80 and above for third person singular, and all but two scoring above .77 for past tense. Mean scores for interpretation of target syntactic measures (active voice, passive voice, subject relative clauses, object relative clauses) from the experimental colouring task showed that, as expected, the bilingual participants demonstrated a high ability in interpretation of sentences defined as less complex (active voice and subject relative clauses) and lower ability in interpretation of sentences described as more complex (passive voice and object relative clauses). The monolinguals demonstrated high ability in interpretation of all target sentences. For mean length of utterance in narrative production, the mean score for the bilingual participants was 9.36 while the mean score for the monolingual participants was 11.36. Mean length of utterances ranged from 3.25 to 16.0 for the bilinguals while the range for the monolingual participants was wider extending from 4.75 to 22.69. Production of embedded narrative clauses revealed that the bilinguals' mean score was 1.34 and ranged from 1.00 to 1.88, while the monolinguals' mean score was 1.42 and ranged from 1.00 to 2.15.

In summary, a comparison of mean scores for language measures showed that the bilingual participants had overall high accuracy in use of third person singular and past tense morphology (measured via the TEGI) and interpretation of active voice and subject relative clauses, with the average score at .75 and above. In contrast, overall performance for expressive lexical range and interpretation of the passive voice and object relative clauses, showed lower mean results with all scores for these measures below .70. Monolingual participants performed well across almost all tasks with mean scores at .80 or above. In terms of expressive morphosyntactic features in narrative storytelling, results revealed that the monolingual participants scored slightly higher than the bilingual participants in relation to mean length of utterance and subordinate and non-finite clauses.

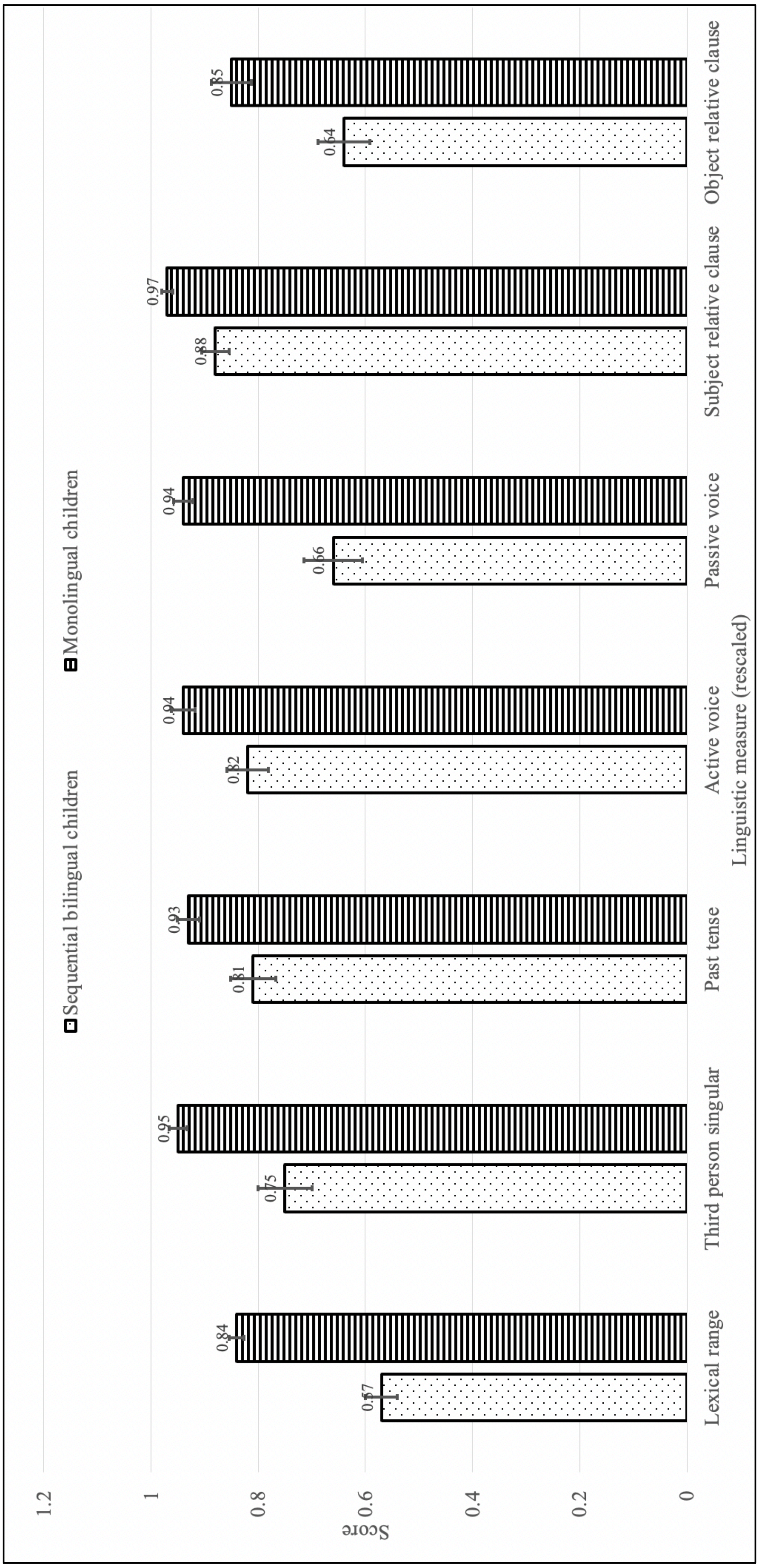

Figure 5.1 Mean scores for vocabulary, morphology (TEGI task) and interpretation of syntax for the bilingual and monolingual participants.

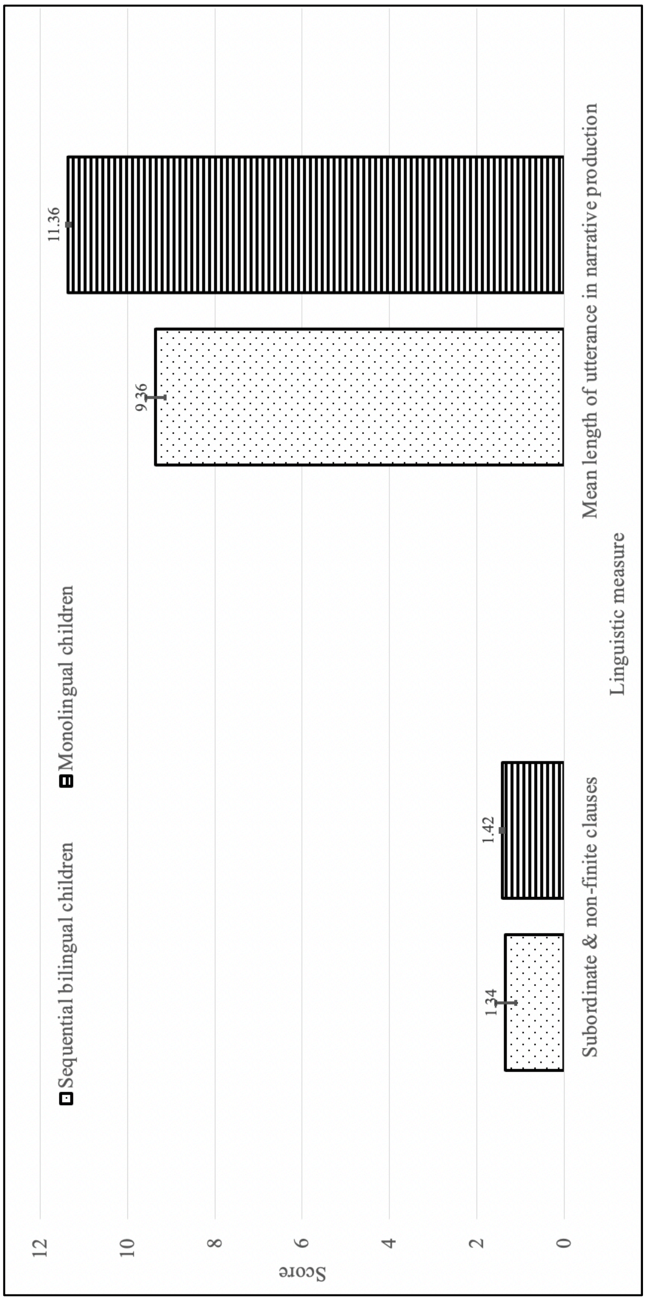

Figure 5.2 Mean scores for narrative linguistic measures (mean length of utterance and use of subordinate and non-finite clauses).

5.2.2 Non-linguistic measures

Descriptive statistics for non-linguistic measures included both internal (chronological age, age of first meaningful exposure to the L2, memory capacity, motivation for learning L2 English) and external (length of L2 exposure, L2 English language use at home, richness of the L2 environment, L2 English language use at school, maternal education, maternal L2 proficiency) factors. The only non-linguistic measures included for the monolingual participants were chronological age and short-term memory.[20] As mentioned previously, mean, standard deviation (SD), range for non-linguistic measures are presented in Tables 5.1-5.2.

Chronological ages for the bilingual participants ranged relatively evenly across age groups (11 participants were aged between 5;0-6;11, 12 were aged between 7;0-8;11, 12 between 9;0-10;11, and 5 between 11;0-12;3, see Appendix (F) for further details). The monolingual participants' chronological ages were less evenly distributed between the same age groups (9 participants were aged between 5;0-6;11, 12 were aged between 7;0-8;11, and 20 between 9;0-10;11) however, for both groups, half or the participants (n=20) or just over, were aged below age 9 and half aged above age 9. In relation to short-term memory capacity, mean scores were similar between the two language groups with monolinguals scoring just six points above the bilinguals. For the bilinguals, age of first meaningful exposure to L2 acquisition varied quite widely among the bilinguals ranging from 5 months to 10 years. However, the majority (30/40) began first meaningful exposure the L2 before age 5. This will be considered further in the discussion section in light of the results.

In relation to environmental measures, length of L2 exposure for the bilinguals ranged widely from 7 months to 10 years 7 months, with a high number of participants (25/40) having less than 5 years of L2 exposure. See Appendix (F) for further details on the chronological ages, lengths of L2 exposure and ages of first meaningful L2 exposure for the bilingual participants. Richness of L2 environment and maternal L2 proficiency both had moderately high mean scores, while maternal education showed average scores in the mid-range. In contrast, L2 English use at home revealed a low mean score compared to the other measures. Scores for L2 English use at school and motivation for learning L2 English revealed that the vast majority of participants were scored 100% for these measures. In other words, their teachers determined that on a scale of 0-100%, most children used English at school

[20] Environment and L2 related factors (e.g., age of first meaningful exposure to the L2, L2 language use at home, and L2 richness of the environment) did not directly apply to the monolingual participants who, by virtue of being speakers of one single language, presumably represent a much more homogenous group making it more difficult to measure any variation in environmental related impact. While some research has challenged the homogenous view of monolingual input (e.g., De Houwer et al., 2014), and though there would certainly be variation among this group in relation to maternal education (socio-economic status measure), as the present study's key aim was measuring impact on sequential bilingual language competency, it was decided that these factors would not be included as measures for the monolingual participants.

100% of the time and were very highly motivated to learn English. For L2 English use at school, 32 of the 40 bilingual participants were scored 100%, and 6 of the 8 participants who were not scored 100%, were scored at 85% or above. For motivation for learning the L2, 28 of the 40 bilingual participants were scored 100%, and 5 of the 12 participants who were not scored 100%, were scored 75% or above. A lack of variation between participants' scores for these variables makes it difficult to determine the impact of target factors. In light of this, L2 use at school and motivation for learning the L2 were removed from further analyses.

A scatterplot showing the patterns of association between the non-linguistic measures for the bilinguals is shown in Figure 5.3. These graphs show that a number of variables appear to be highly correlated (e.g., age of L2 onset and length of L2 exposure, and maternal education and maternal L2 proficiency). These correlations will be investigated more in-depth in the flowing section.

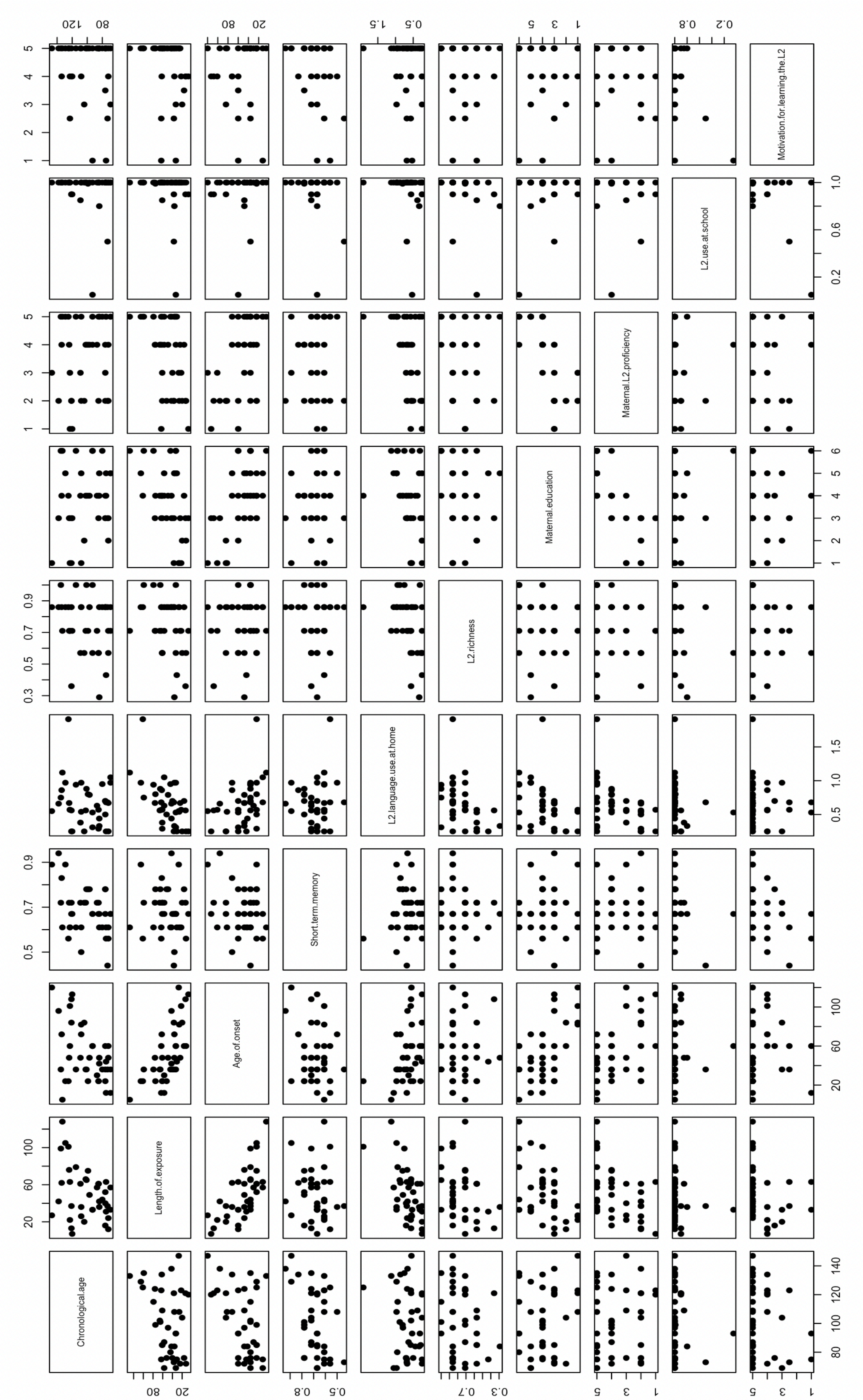

Figure 5.3 Scatterplot matrix showing patterns of association between non-linguistic factors.

5.3 Statistical analysis

To determine the specific independent variables which predict each linguistic measure, we performed linear mixed effects modelling using R (R Core Team, 2018) and lme4 (Bates et al., 2020). For expressive vocabulary and morphology (third person singular and past tense using the TEGI task) and interpretation of sentence structures, generalized linear mixed effects modelling was used to establish if ACCURACY in production or interpretation of linguistic measures was predicted by the target internal and external factors.[21] For expressive morphosyntax in narrative production, linear mixed effects modelling was used to establish if MEAN LENGTH OF UTTERANCE and use of SUBORDINATE AND NON-FINITE CLAUSES was predicted by the target factors.[22] Mean length of utterance (MLU) for all participants' narrative stories was calculated using the 'MLU morphemes' count completed via the 'kideval' command in CLAN. MLU morphemes refer to the average number of morphemes per narrative utterance used by the participant. Use of subordinate or non-finite (embedded) clauses were measured by calculating the following: summing the number of utterances used to describe the pictures in the narrative storytelling task and the number of embedded clauses used in the utterances to give a total score for independent and dependent clauses, and then dividing this by the number of utterances/independent clauses to give a proportional score.

As shown previously through the scatterplot matrix of patterns of association between non-linguistic factors, a number of the variables were correlated. Before running the models in the statistical programme, a correlation analysis was conducted to investigate this further so to identify any collinearity between predictor variables. Collinearity may result in measuring an unintended variable (separate

[21] Logistic regression of this type has binary outcome variables (e.g., correct/incorrect, yes/no, etc.) which were converted to numerical values of either zero or one, with zero indicating failure and one indicating success (Garson, 2014; Grace-Martin, 2018). In the present study, the outcome of each individual response for each trial (i.e., each test item of each linguistic measure) indicated either success (i.e., correct=1) or failure (i.e., incorrect=0) in accurately interpreting or producing the target linguistic measure. In logistic regression modelling, an estimation of maximum likelihood is used to predict the behaviour of the dependent variable by calculating the most likely values reflecting the population under consideration given what has been observed in the dataset (Baayen, 2008; Vegetti, 2015). This is determined by measuring the odds (to determine the logit or link function) which involves dividing the number of successes by the number of failures. In the present study, logistic regression analysis calculated the maximum likelihood of the dependent measure being successful (i.e., accuracy or '1' in responding to target linguistic items) by way of dividing the number of accurate responses by the number of inaccurate responses.

[22] Linear mixed effects modelling involved data with a Gaussian, continuous probability distribution.

from but related with the target factor) alongside the intended variable thereby misrepresenting the causal relationship between dependent and independent variables and obscuring the actual true impact of the target predictor (Grimes & Schultz, 2002; Jager et al., 2008; Skelly et al., 2012). In terms of the statistical analysis, variables which are strongly correlated and inputted in the same statistical model results in a model which cannot differentiate between the variables. Therefore, it is difficult, if not impossible, to tease apart the effect of the two predictors (Blom et al., 2016). To further investigate the association and collinearity between factors, a correlation analysis was conducted to identify the correlation coefficients between independent variables (Table 5.3).

Table 5.3 Correlation analysis (r-values) of predictor variables for the bilingual participant data.

	Chronological age	Length of L2 exposure	Age of L2 onset	Short-term memory	L2 language use at home	Richness of the L2 environment	Maternal education	Maternal L2 proficiency
Chronological age								
Length of L2 exposure	0.35.							
Age of L2 onset	0.47.	**-0.67***						
Short-term memory	0.40.	0.11	0.21					
L2 language use at home	0.18	**0.59***	-0.41.	-0.08				
Richness L2 environment	0.18	0.29	-0.13	0.08	0.42.			
Maternal education	-0.18	0.49.	**-0.60***	-0.10	0.46.	0.15		
Maternal L2 proficiency	-0.18	0.49.	**-0.60***	-0.10	0.46.	0.15	**1*****	

'***' Correlation coefficient between 0.9 and 1.0 (very high correlation); '**'correlation coefficient between 0.7 and 0.9 (high correlation); '*' correlation coefficient between 0.5 and 0.7 (moderate correlation); '.' correlation coefficient between 0.3 and 0.5 (low correlation); ' ' correlation coefficients less than 0.3 (little if any correlation) (Calkins, 2005).

A correlation coefficient of 0.5 or above was deemed as important (moderate to high correlation; Calkins, 2005).[23] The correlation analysis revealed the following important correlations:

- A perfect positive correlation between maternal education and maternal L2 proficiency (r-value = 1.0) (Figure 5.4).

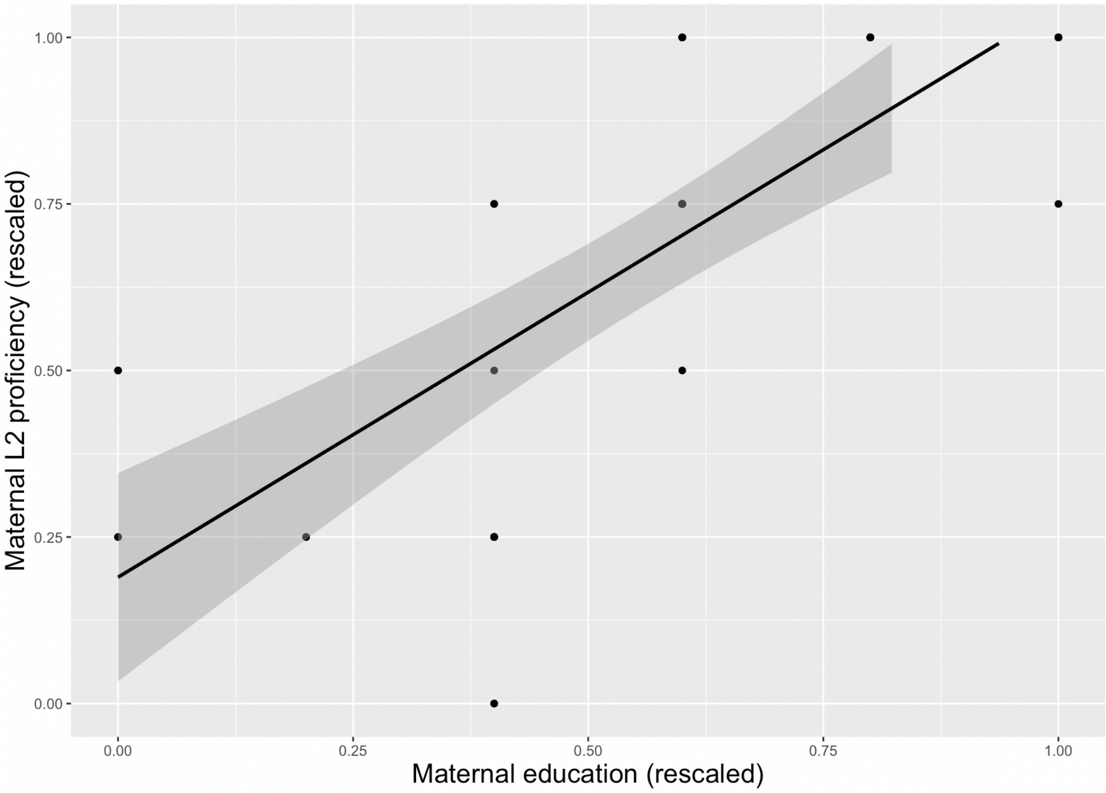

Figure 5.4 Correlation graph between maternal education and maternal L2 proficiency

[23] Following Calkins (2005), the magnitude of correlation coefficients were determined as follows: between 0.9 and 1.0 indicate variables which can be considered very highly correlated; correlation coefficients between 0.7 and 0.9 indicate variables which can be considered highly correlated; correlation coefficients whose magnitude are between 0.5 and 0.7 indicate variables can be considered moderately correlated; correlation coefficients whose magnitude are between 0.3 and 0.5 indicate variables which have a low correlation; and finally, correlation coefficients whose magnitude are less than 0.3 have little if any (linear) correlation.

- A high-moderate negative correlation between length of L2 exposure and age of L2 onset (r-value = -0.67) (Figure 5.5).

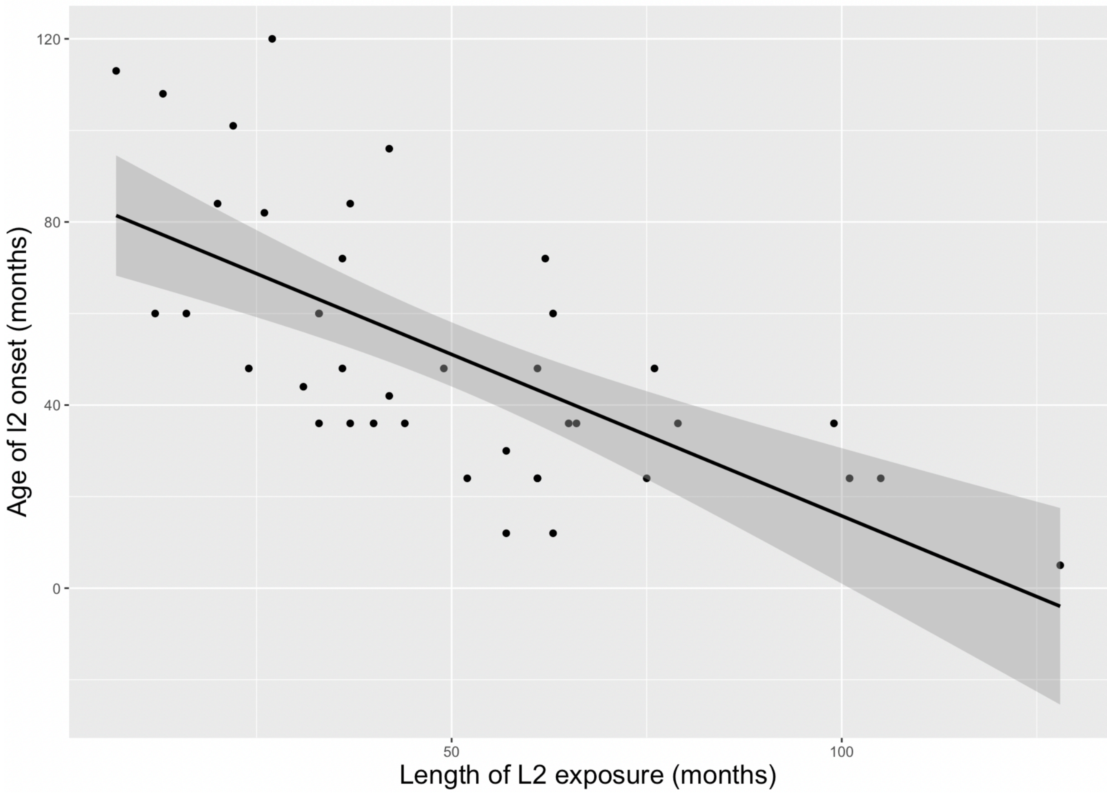

Figure 5.5 Correlation graph between length of L2 exposure and age of L2 onset

- A moderate negative correlation between age of L2 onset and both maternal education and maternal L2 proficiency (r-value = -0.60) (Figures 5.6-5.7).

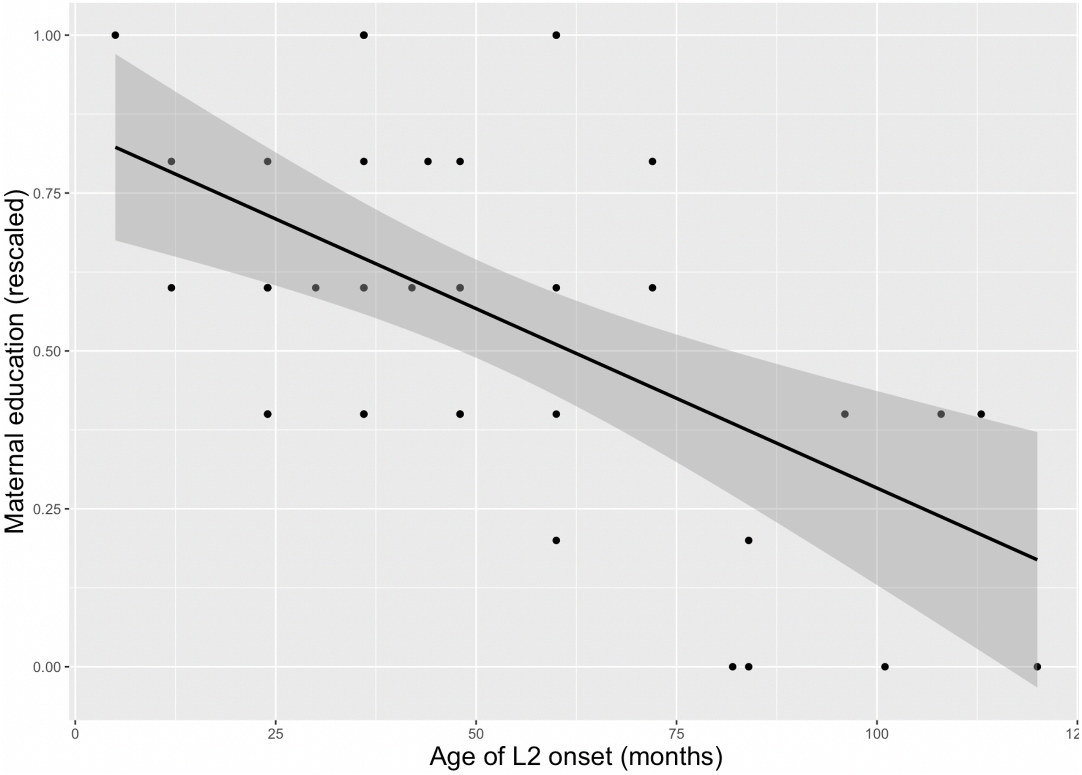

Figure 5.6 Correlation graph between age of L2 onset and maternal education

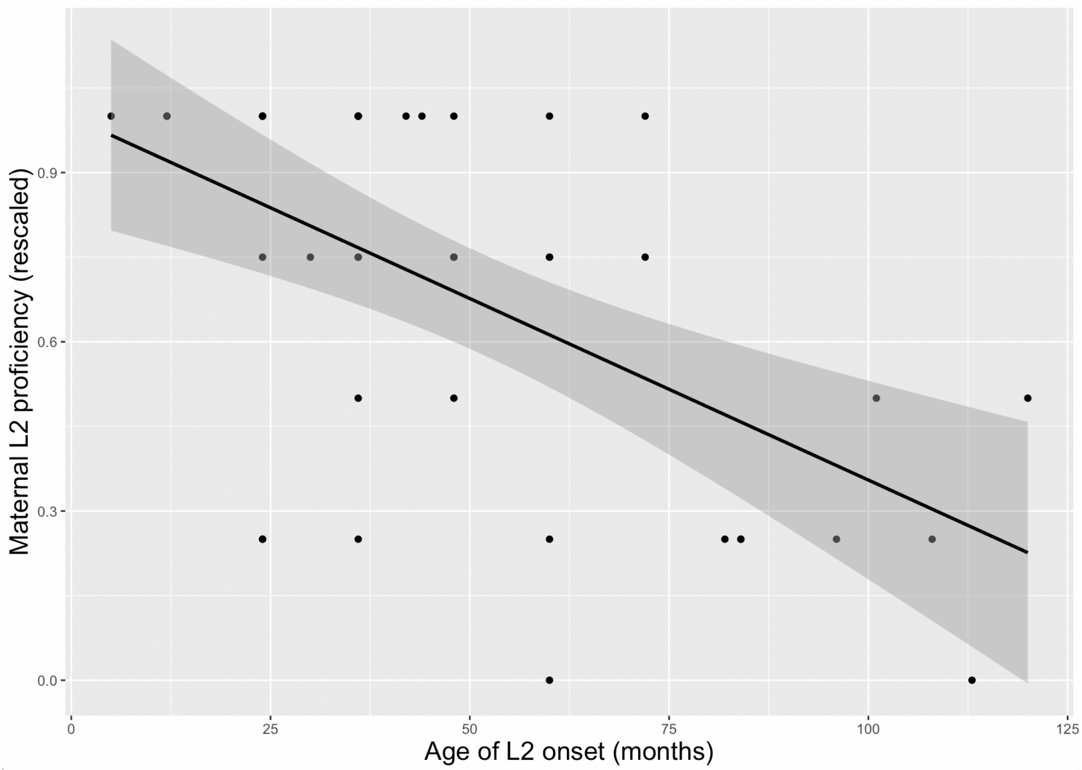

Figure 5.7 Correlation graph between age of L2 onset and maternal L2 proficiency

- A moderate correlation between length of L2 exposure and L2 language use at home (r-value = .59) (Figure 5.8).

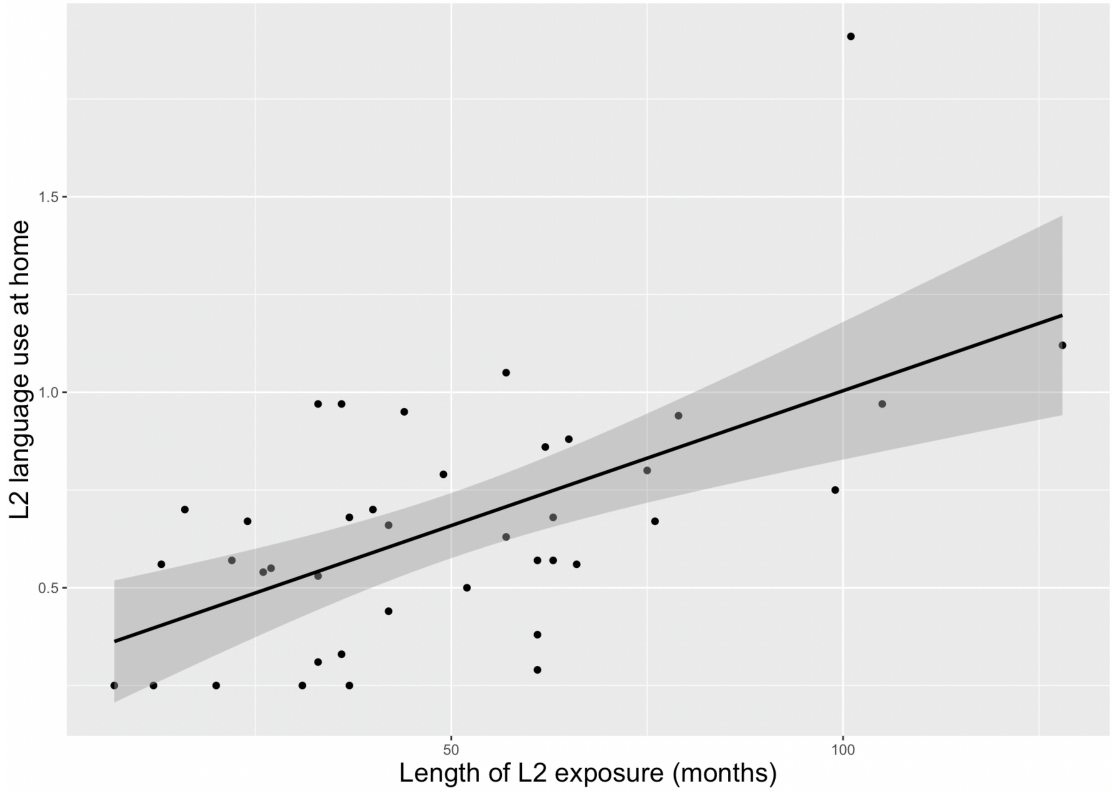

Figure 5.8 Correlation graph between L2 language use at home and length of L2 exposure

The correlation between MATERNAL EDUCATION, and MATERNAL L2 PROFICIENCY revealed that there was a perfect positive correlation between these factors (Table 5.3; Figure 5.3). This may not be entirely surprising as it would likely be the case that those who have higher educational levels would also have higher levels of English language ability. Measuring these factors in the same statistical model would mean it would not be possible to tease the impact of the variables apart. Instead of excluding one of factors it was decided that these variables would be combined to create a composite measure to represent SOCIOECONOMIC STATUS.[24]

To reduce dimensionality between the other variables which revealed high-moderate or moderate correlations (length of L2 exposure and age of L2 onset;

[24] We wish to extend our thanks to Cecile De Cat who suggested using this composite measure as a representation of *socio-economic status*.

length of L2 exposure and L2 language use at home), a Principal Component Analysis was conducted to show the proportion of variance in the data each of these factors accounted for. This was determined by way of calculating the variables' eigenvalues. This allowed us to determine the importance of the factors and decide which, if any, variables could be retained or removed from further analysis (Jaadi, 2021). Calculations of the eigenvalues via eigenvectors between LENGTH OF L2 EXPOSURE and AGE OF L2 ONSET revealed that LENGTH OF L2 EXPOSURE accounted for 81% of the variance in the data while AGE OF L2 ONSET accounted for 19% of the variance in the data. Calculations of the eigenvalues via eigenvectors between LENGTH OF L2 EXPOSURE and L2 LANGUAGE USE AT HOME revealed that LENGTH OF L2 EXPOSURE accounted for 80% of the variance in the data and L2 LANGUAGE USE AT HOME accounted for 20% of the variance in the data. Therefore, LENGTH OF L2 EXPOSURE accounted for a substantially and extensively higher proportion of the data in comparison to the other two variables. In light of this, LENGTH OF L2 EXPOSURE was retained as a predictor and AGE OF L2 ONSET and L2 LANGUAGE USE AT HOME were removed from further analysis.

For the bilingual participants, the following fixed effects were entered into each model: ACCURACY/MEAN LENGTH OF UTTERANCE/SUBORDINATE AND NON-FINITE CLAUSES, CHRONOLOGICAL AGE, SHORT-TERM MEMORY, LENGTH OF L2 EXPOSURE, RICHNESS OF THE L2 ENVIRONMENT, and SOCIOECONOMIC STATUS. For the monolingual participants, ACCURACY/MEAN LENGTH OF UTTERANCE/SUBORDINATE AND NON-FINITE CLAUSES, CHRONOLOGICAL AGE, and SHORT-TERM MEMORY were entered into each model.[25]

[25] A correlation analysis between final variables revealed that all correlation coefficients were below 0.5 indicating that there was low, or little or no, correlation between the final factors. See Appendix (G) for further information on this correlation analysis.

'Items' (i.e., each item from the target linguistic measures), 'participants' and 'school' were entered as random effects.[26] Data were rescaled and standardized before being entered into the model.[27]

For each participant group (bilinguals and monolinguals) there were 4 models which corresponded to each task: vocabulary (Renfrew word finding task); morphology (third person singular and past tense measured using the TEGI task); interpretation of syntax (active and passive voice and subject and object relative clauses using the colouring task); and expressive morphosyntax in narrative storytelling which included mean length of utterance and subordinate and non-finite (embedded) clauses. For the morphology model, MORPHEME was included as a main effect so that the impact of internal and external factors could be determined across the two types of morphological features (third person singular and past tense). For

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[26] Mixed effects logistic regression allows random factors to be included and accounted for alongside fixed effects. Fixed effects are those factors which remain constant across individuals and any variation caused by them is the same throughout a population, e.g., gender or age (Baayen, 2008). In contrast, random effects are those which do change across the population and in the present study included 'participant', 'item', and 'school' as in each case they represented a small selection of a greater pool of possible options which may have undetermined characteristics which could impact results (Blom et al., 2008). For instance, the study's bilingual participants were a nominal representation of the larger global bilingual population of children. In terms of the items used to measure linguistic accuracy, they were a small selection of a huge number of possible items which could be included, with each having a particular format and including particular lexical items. In relation to the schools which the bilingual participants attended, each may have varied in the amount of English as an additional language support given to newcomer children – some had substantial resources (e.g., dedicated EAL/newcomer teachers, classrooms and materials) while others had less. Consequently, these factors ('participant', 'item' and 'school') cannot be incorporated without some form of error. However, inclusion as random effects in the statistical model converts these effects to have a mean of zero and unknown variance which allows results to be generalised to the wider population (Blom et al., 2008).
While 'participant', 'item' and 'school' were entered as random effects for the generalised linear regression analyses for all language measures, the inclusion of 'participant' in the linear regression analyses for MLU and embedded clauses in narrative production led to model nonconvergence. This was due to the use of average scores for these language features whereby 'participant' had the same number of levels (i.e., one) as observations and therefore no variation of this factor would be observed. Therefore. 'participant' was removed from the final model in the model for these language measures.

[27] It was the case that much of the data was recorded using different scales (e.g., ages were recorded in months ranging from 63-147 months, while L2 language use at home was recorded on a 5-point rating scale-1-5). This can create difficulties in appropriately comparing variables as predictor means will vary greatly. Therefore, before data were analysed, feature scaling was conducted to convert the different scales of predictors to a fixed range between 0-1 across all variables. Otherwise, the statistical programme may erroneously consider a greater value to have a larger contributory value for its impact on the dependent variable compared to lower values and therefore produce incorrect predictions. Data were also standardized before analyses so that the intercept of each predictor variable was adjusted to its mean, with the mean value at zero and data points conveyed in relation to how much they were above or below this mean.

the interpretation of syntax model, STRUCTURE and COMPLEXITY were included as main effects to determine whether the impact of internal and external factors depended on the type of language structure (voice or relative clause) and the language feature's complexity (low - active voice and subject relative clause; high – passive voice and object relative clause). For the expressive morphosyntax model, LANGUAGE FEATURE was included as a main effect so that the impact of internal and external factors could be determined across the two types of expressive morphosyntax in narrative production (mean length of utterance and embedded clauses).

From a model which overfitted the data, backwards stepwise elimination of fixed effects which were not significant resulted in a reduced model.[28] This model represented those predictors whose inclusion contributed to the best fit for the data. The model complexity was then increased by entering interactions between significant predictors.[29] Nested models which differed in the number of parameters were compared using likelihood ratio tests. This resulted in a final model which balanced having those predictors which contributed to a better explanation of the data and which was as parsimonious as possible (Paradis et al., 2017). The R code used for the logistic analyses is given in Appendix (H).

As noted in the methodology chapter, eight of the sequential bilingual participants were trilingual as opposed to bilingual speakers. Some research has found advantages for acquisition of a third language (L3) in comparison to those acquiring the same target language as an L2 (e.g., Bild & Swain, 1989; Cenoz &

[28] Backwards elimination for each linguistic measure began by creating a 'full' model containing all main effects (i.e., for the bilingual participants this included the following predictors: chronological age, length of L2 exposure, short-term memory capacity, richness of the L2 environment and socio-economic status). Then, models containing combinations of all predictors less one (i.e., containing 4 of the 5 possible predictors) were created and compared to the 'full' model using likelihood ratio tests to determine if the removal of that particular predictor did or did not significantly reduce the fit of the model. A significant chi squared (χ^2) value indicated that the restricted model (i.e., the model with less predictors) significantly reduced the fit of the model and therefore the missing predictor should be retained in the model. In contrast, non-significant chi squared values indicated that the restricted model did not significantly reduce the fit of the data and therefore the missing predictor should be removed.

[29] An interaction specifies that the dependent variable has a different trend in relation to the impact of a particular predictor variable depending on another variable. Interactions between variables are prevalent in language research (Winter, 2020) and therefore it is important that these are included in analyses to have a fuller understanding of the associations between variables. Statistical analyses determine interactions by multiplying the predictors by each other.

Valencia, 1994; Sanz, 2000). However, being trilingual was not accounted for in the statistical analysis. This was because the trilingual children's scores for language measures did not deviate substantially from the sequential bilinguals' mean language scores.[30] See Appendix (I) for further details. The issue of trilingual versus bilingual speakers will be considered further in the discussion chapter.

The following sections will present the results of the statistical analyses for the bilinguals (5.4) and the monolinguals (5.5).

5.4 Linear regression results - sequential bilingual participants

The results of the linear regression analyses will be preceded by previous research findings for each linguistic domain in sequential bilingual acquisition. For ease of presentation, these are summarised in a table.

5.4.1 Lexical proficiency

Lexical proficiency in the present study was measured by using the Word Finding Vocabulary Test (Renfrew, 1995). Previous research demonstrates that lexical development (both receptive and expressive) in sequential bilingual acquisition is mostly predicted by chronological age, age of L2 onset, short-term and working memory capacity, current and cumulative exposure to the second language, socio-economic status, and parental L2 proficiency (Table 5.4).

Table 5.4 Previous findings and predictions for the impact of target factors on lexical proficiency in sequential bilingual acquisition

Factor	Positive	Negative	No relationship
Age of L2 onset	• Blom & Bosma, 2016	N/A	• Unsworth, 2016

[30] To ascertain whether the trilingual children's language ability deviated considerably (shown across a large number of the trilingual children) from the bilingual children, their scores for language measures were compared to the overall mean scores across the sequential bilingual children (bilinguals and trilinguals) - see Appendix (I). This comparison shows that a small number of the trilingual children (1-3) showed lower scores for a number of the language measures compared to the bilingual mean scores. However, the majority of the scores for the language measures of the trilingual children were similar to the sequential bilingual mean scores. Therefore, it was decided that accounting for these children's trilingualism within the statistical analysis was not required.

	• Snedeker et al., 2007 • Golberg et al., 2008		
Chronological age	• Paradis, 2011 • Snow & Hoefnagel-Hohle, 1978	N/A	• Snedeker et al., 2007 (2;7-5;8)
Memory capacity	• Thorn & Gathercole, 1999 (Working memory) • Engel de Abreu et al., 2011 (Working memory) • Verhagen & Leseman, 2016 (Short-term memory) • De Cat, 2020 (Short-term memory and working memory)	N/A	• Engel de Abreu et al., 2011 (Cognitive control) • Verhagen & Leseman, 2016 (Working memory)
Input: L2 language use at home Richness of the L2 environment L2 language use at school	• De Cat, 2020 (Cumulative exposure) • Unsworth, 2016 (Current exposure) • Sorenson Duncan & Paradis, 2018 (Cumulative exposure at school;	N/A	• Unsworth, 2016 (Cumulative exposure)

	mother's relative L2 input)		
Maternal education	• Oller & Eilers, 2002	N/A	N/A
Maternal L2 proficiency	• Chondrogianni & Marinis, 2011	N/A	• Sorenson Duncan & Paradis, 2018

Stepwise elimination of fixed effects which did not reach significance revealed that vocabulary proficiency was predicted only by LENGTH OF L2 EXPOSURE ($\chi^2(1) = 16.356$, p=<.001). This effect was also significant in the final model (Table 5.5).

Table 5.5 Impact of predictors from fitted model on lexical proficiency

Predictor variables	β	Z	p
Intercept	.600	1.158	.247
Length of L2 exposure	1.070	4.622	.001***

.p<.1, *p<.05, **p<.01, ***p<.001

The main effect of LENGTH OF L2 EXPOSURE is reflected in Figure 5.9; specifically, those who had longer exposure to L2 English had higher expressive lexical proficiency than those who had less exposure to L2 English.

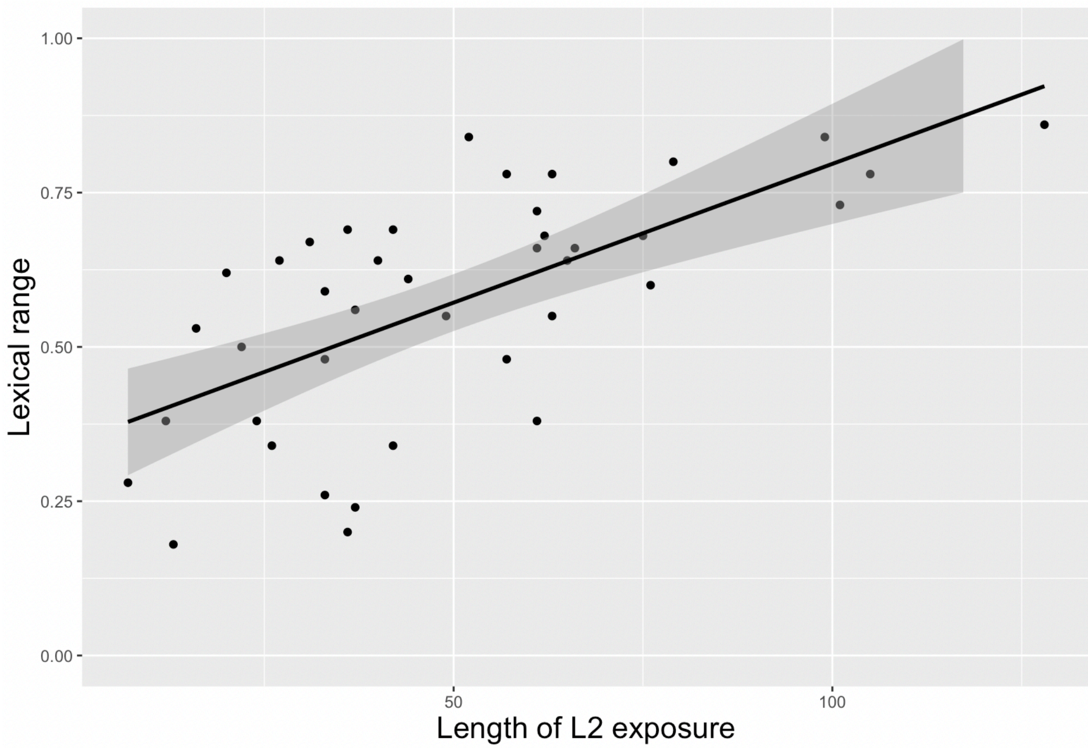

Figure 5.9 Expressive lexical proficiency by LENGTH OF L2 EXPOSURE (years)

The impact of length of L2 exposure on lexical proficiency supports previous results finding an effect for this variable (e.g., De Cat, 2020; Sorenson Duncan & Paradis, 2018; Unsworth, 2016). No significant impact was found for any of the other target predictor variables which contrasts findings from previous research. This includes chronological age (e.g., Paradis, 2011; Snow & Hoefnagel-Hohle, 1978), age of L2 onset (e.g., Blom & Bosma, 2016; Golberg et al., 2008; Snedeker et al., 2007; Unsworth, 2016) and short-term memory (e.g., De Cat, 2020; Verhagen & Leseman, 2016). The finding that socio-economic status (including maternal influences such as maternal L2 proficiency and maternal education) did not significantly impact lexical proficiency both contrasts (e.g., Chondrogianni & Marinis, 2011, and Oller & Eilers, 2002, respectively) and supports (e.g., Sorenson Duncan & Paradis, 2018) previous results. These findings will be explored further in the subsequent chapter.

5.4.2 Morphology – TEGI tasks

Morphological measures in the present study included separate elicited evaluations of third person singular and past tense morphemes using the TEGI screening tool (Rice & Wexler, 2001). Use of morphology in terms of mean length of utterance will be presented in the results section on the narrative storytelling task (section 5.4.3.2). Previous research (Table 5.6) on morphological development in sequential bilingual acquisition demonstrates a (mostly) positive effect of chronological age and short-term memory capacity. Input is also shown to affect morphological competence with longer L2 exposure, richness of the L2 environment, and a combined measure of input, shown to impact morphology (e.g., Chondrogianni & Marinis, 2011; Paradis, 2011; Unsworth et al., 2014; Unsworth, 2016). Maternal education and maternal L2 proficiency have not been shown to impact morphological proficiency (e.g., Chondrogianni & Marinis, 2011; Paradis, 2011). No relationship is found for the impact of age of L2 onset however, some research shows that a younger age of L2 onset advantage may manifest if proficiency is measured longitudinally (e.g., over 5 years, as in Jia & Fuse, 2007). Other research has found that age of L2 onset interacted with motivation in the proficiency of morphology in that, participants with younger ages of L2 onset (as measured by age of arrival to the L2 speaking country) switched their preference for using the L2 earlier than older L2 participants which positively impacted proficiency (Jia & Aaronson, 2003). In summary, previous research shows that overall, chronological age, short-term memory, motivation (via younger age of L2 onset), and language exposure, impact the morphological proficiency of sequential bilingual children.

Table 5.6 Previous findings and predictions for the impact of target factors on morphological proficiency in sequential bilingual acquisition

Factor	Positive	Negative	No relationship
Age of L2 onset	• Blom & Paradis, 2015	• Jia & Fuse, 2007 • Johnson & Newport, 1989	• Paradis & Blom, 2016 • Unsworth, 2016 • Blom & Bosma, 2016

			• Snedeker et al., 2007 • Unsworth et al., 2014
Chronological age	• Paradis, 2011 • Snow & Hoefnagel-Hohle, 1978	N/A	• Chondrogianni & Marinis, 2011
Memory capacity	• Paradis, 2011 (Short-term memory) • Paradis et al., 2016 (Short-term memory)	N/A	N/A
Motivation for learning the L2	• Jia and Aaronson, 2003	N/A	N/A
Input: L2 language use at home Richness of the L2 environment L2 language use at school	• Unsworth, 2016 (Current L2 input) • Paradis, 2011 (Richness of the L2 environment) • Chondrogianni & Marinis, 2011 (Length of exposure) • Unsworth et al., 2014 (Cumulative input)	N/A	• Unsworth, 2016 (Cumulative L2 input) • Paradis, 2011 (L2 use at home)

Maternal education	N/A	N/A	• Paradis, 2011 • Chondrogianni & Marinis, 2011
Maternal L2 proficiency	N/A	N/A	• Paradis, 2011 • Chondrogianni & Marinis, 2011

Like for vocabulary, the stepwise elimination procedure revealed that morphological proficiency was predicted by LENGTH OF L2 EXPOSURE ($\chi^2(1) = 3.854$, p=.049); in addition, proficiency was predicted by MORPHEME ($\chi^2(1) = 4.728$, p=.029). These effects were reflected in the final model, with a main effect of LENGTH OF L2 EXPOSURE and MORPHEME (Table 5.7).

Table 5.7 Impact of predictors from fitted model on accuracy of morphology

Predictor variables	β	Z	p
Intercept	2.551	6.274	.001***
Morpheme (third person singular and past tense)	-0.767	-2.240	.025*
Length of L2 exposure	.849	1.997	.003**

.p<.1, *p<.05, **p<.01, ***p<.001

The main effect of LENGTH OF L2 EXPOSURE reflects that those who had longer exposure to L2 English had greater accuracy for morphology compared to those who had less exposure to L2 English, for both third person singular (yellow line) and past tense (blue line) morphology (Figure 5.10).

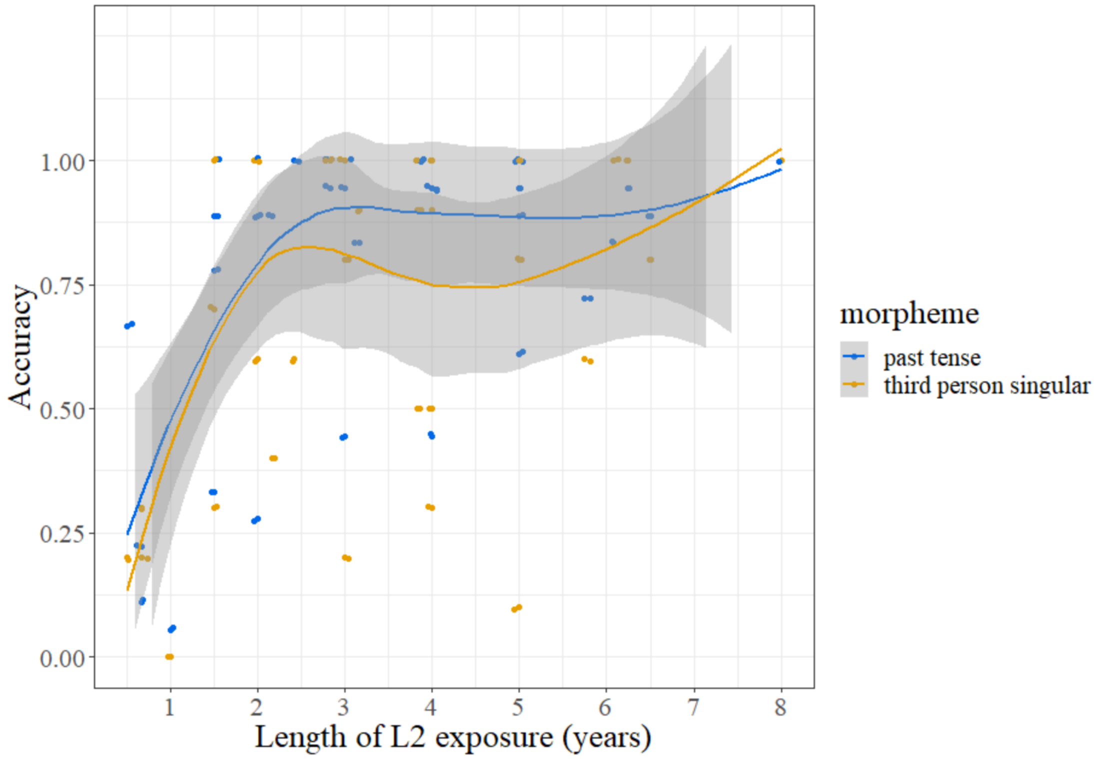

Figure 5.10 Accuracy in using morphology by LENGTH OF L2 EXPOSURE.

In relation to previous research, most studies have investigated morphology as a composite measure of both expressive third person singular and past tense morphemes from a standardised elicitation task. In the current study, the impact of length of L2 exposure on proficiency of both third person singular and past tense morphemes supports previous results finding an effect for this variable (e.g., Chondrogianni & Marinis, 2011; Unsworth et al., 2014; Unsworth, 2016). Meanwhile, the finding that age and short-term memory do not predict morphology contrasts previous research (e.g., Blom & Paradis, 2015; Paradis, 2011; Paradis et al., 2016; Snow & Hoefnagel-Hohle, 1978) while the results revealing no impact for socioeconomic status supports previous research (e.g., Chondrogianni & Marinis, 2011; Paradis, 2011). These findings will be explored further in the discussion chapter.

5.4.3 Morphosyntax

The target syntactic structures in the present study were measured using an experimental colouring task (The Coloring Book task; Pinto & Zuckerman, 2018) and a narrative storytelling task (ENNI, Schneider et al., 2005). In the colouring task, syntax was measured via interpretation of active and passive voice and subject and object relative clauses. Complexity (low versus high) was measured by voice (active versus passive) and relative clause extraction (subject versus object). In the narrative storytelling task, syntax was measured via production of subordinate and non-finite (embedded) clauses. The narrative task also included a measure of morphological complexity as evaluated through mean length of utterance. As with the preceding language tasks, separate models for each task type were analysed: one for interpretation of syntactic structures (experimental colouring task); and the other for production of embedded clauses and mean length of utterance (narrative task).

Previous research (Table 5.8) demonstrates that chronological age and short-term memory capacity mostly predict use and comprehension of more complex sentence structures (including passives, subordinate clauses, wh-questions and subject-verb inversion), while findings for age of L2 onset are mixed. In relation to input, cumulative exposure (mostly) impacts proficiency. When types of input are measured individually, richness of the L2 environment (as measured by way of L2 play, social activities and TV) is shown to positively impact syntactic competence. Mixed findings are also shown for the impact of both maternal education and maternal L2 proficiency.[31]

Table 5.8 Previous findings and predictions for the impact of target factors on syntactic proficiency in sequential bilingual acquisition

Factor	Positive	Negative	No relationship
Age of L2 onset	• Rothman et al., 2016 (Passive voice)	• Nishikawa, 2014 (Relative clauses) • Johnson & Newport, 1989 (Word order, wh-questions and subcategorization)	• Unsworth, 2016 (Object scrambling) • Paradis et al., 2017 (Coordinate, complement,

[31] No literature reviewed in this thesis has included mean length of utterance as a linguistic measure. Therefore, the impact of factors on this measure for sequential bilingual children and in terms of previous research, is unknown.

		• Bedore et al., 2016 (passive voice, negatives, and question inversion) • Roesch & Chondrogianni, 2016 (Subject and object wh-questions)	adverbial and relative clauses) • Chondrogianni & Marinis, 2011 (Wh-questions and passive voice)
Chronological age	• Bohman et al., 2010 (Passive voice, negative sentences, and wh-questions) • Armon-Lotem et al., 2011 (Relative clauses and passive voice) (L1 Russian children acquiring L2 German) • Paradis et al., 2017[32] • De Cat (2020)	N/A	• Chondrogianni & Marinis, 2011
Memory capacity	• Engel de Abreu et al., 2011(Grammatical contrasts marked by inflections, function words and word	N/A	• De Cat, 2020 (Working memory)

[32] This was found by contrasting participants' use of sentences with those reported in other studies for younger (aged between 2;0 and 4;0) L1 learners (Diessel, 2004; Huttenlocher et al., 2010; Vasilyeva et al., 2008).

	order) (Working memory and cognitive control) • Verhagen & Leseman, 2016 (Subject-verb inversion) (Short-term memory and working memory) • Paradis et al., 2017 (Working memory) • De Cat, 2020 (Passives, object wh-questions and object relative clauses) (Short-term memory)		
Motivation for learning the L2	• Jia and Aaronson, 2003 (Wh-questions, word order, and pronominalization)	N/A	N/A
Input: L2 language use at home Richness of the L2 environment L2 language use at school	• Paradis et al., 2017 (Richness of the L2 environment) • Roesch & Chondrogianni, 2016 (Cumulative exposure) • Sorenson Duncan & Paradis, 2018 (Complex narrative	N/A	• Chondrogianni & Marinis, 2011 (Use of L2 English at home) • Paradis & Kirova, 2014 (Coordinate, complement, adverbial and

	clauses) (Cumulative exposure at school; child's relative L2 output) • De Cat, 2020 (Cumulative exposure)		relative clauses) (Use of L2 English at home) • Paradis et al., 2017 (Use of L2 English at home) • Unsworth, 2016 (Current and cumulative exposure)
Maternal education	• Bohman et al., 2010 • Sorenson Duncan & Paradis, 2018	N/A	• Paradis et al., 2017 • Armon-Lotem et al., 2011
Maternal L2 proficiency	• Chondrogianni & Marinis, 2011 • Sorenson Duncan & Paradis, 2018	N/A	• Paradis et al., 2017

In summary, previous research shows that chronological age, short-term and working memory, motivation (via younger age of onset) and language exposure impact a range of syntactic structures, while results for age of L2 onset and maternal influences are more mixed.

5.4.3.1 Interpretation of syntactic structures

The optimal model for interpretation of syntax included the predictors CHRONOLOGICAL AGE ($\chi^2(1) = 5.9085$, p=.015), RICHNESS OF THE L2 ENVIRONMENT ($\chi^2(1) = 6.5289$, p=.011), and COMPLEXITY ($\chi^2(1) = 45.411$, p=<.001). In addition, a likelihood ratio test confirmed that the model with an interaction between

COMPLEXITY, CHRONOLOGICAL AGE, and RICHNESS OF THE L2 ENVIRONMENT outperformed the model without the interaction ($\chi^2(1) = 6.468$, $p=.011$), suggesting that the interaction between these factors was a significant predictor for accuracy.

These effects were reflected in the model (Table 5.9), with main effects of CHRONOLOGICAL AGE (Figure 5.11-5.14) and RICHNESS OF THE L2 ENVIRONMENT (Figure 5.15-5.18), in addition to an effect of COMPLEXITY due to higher accuracy for less complex structures. However, there was also a significant interaction between CHRONOLOGICAL AGE and RICHNESS OF THE L2 ENVIRONMENT for the language features with high complexity: for both passives (Figure 5.19) and object relative clauses (Figure 5.20), the effect of RICHNESS OF THE L2 ENVIRONMENT was modulated by age, such that older children exhibited higher accuracy with a richer environment (i.e. more participation in play and social activities in the L2), but this effect was not observed for younger children.

Table 5.9 Generalised linear mixed-effects regression modelling results for impact of factors on interpretation of syntactic structures.

Predictor variables	β	Z	p
Intercept	.709	3.791	.001***
Complexity (passive voice and object relative clauses)	1.386	2.027	.001***
Chronological age	1.737	2.513	.012*
Richness of the L2 environment	.622	3.654	.001***
Complexity(high)*age*L2richness	.701	3.195	.001***
Complexity(low)*age*L2richness	.259	1.153	.249

.p<.1, *p<.05, **p<.01, ***p<.001

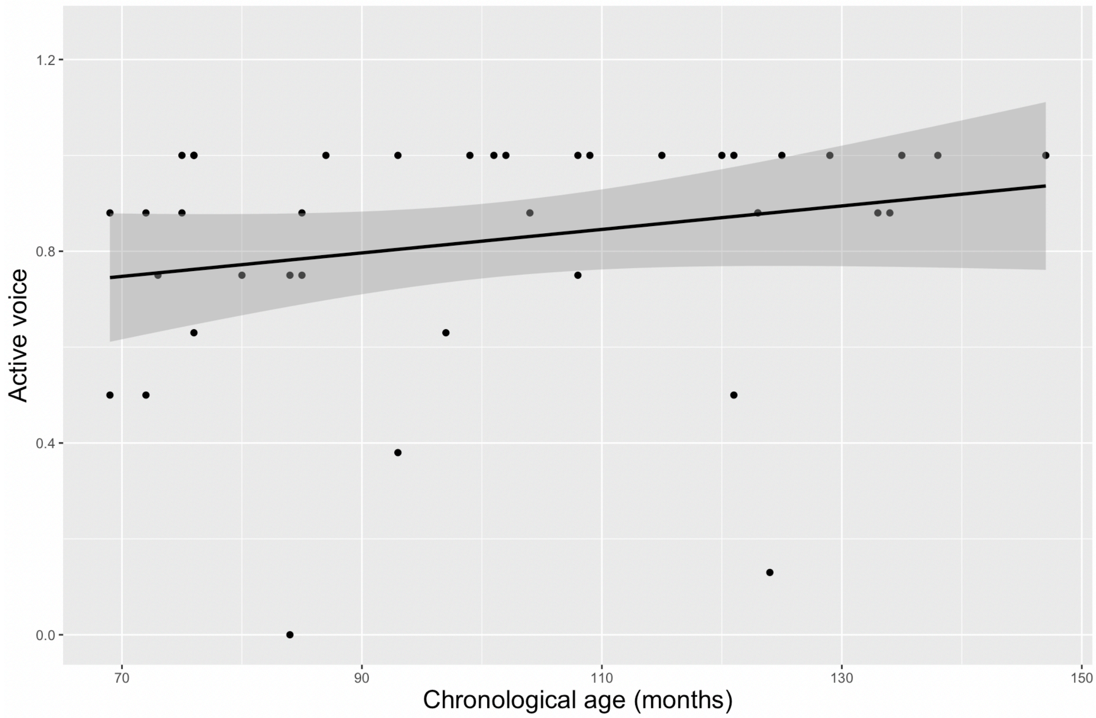

Figure 5.11 Interpretation of active voice by CHRONOLOGICAL AGE

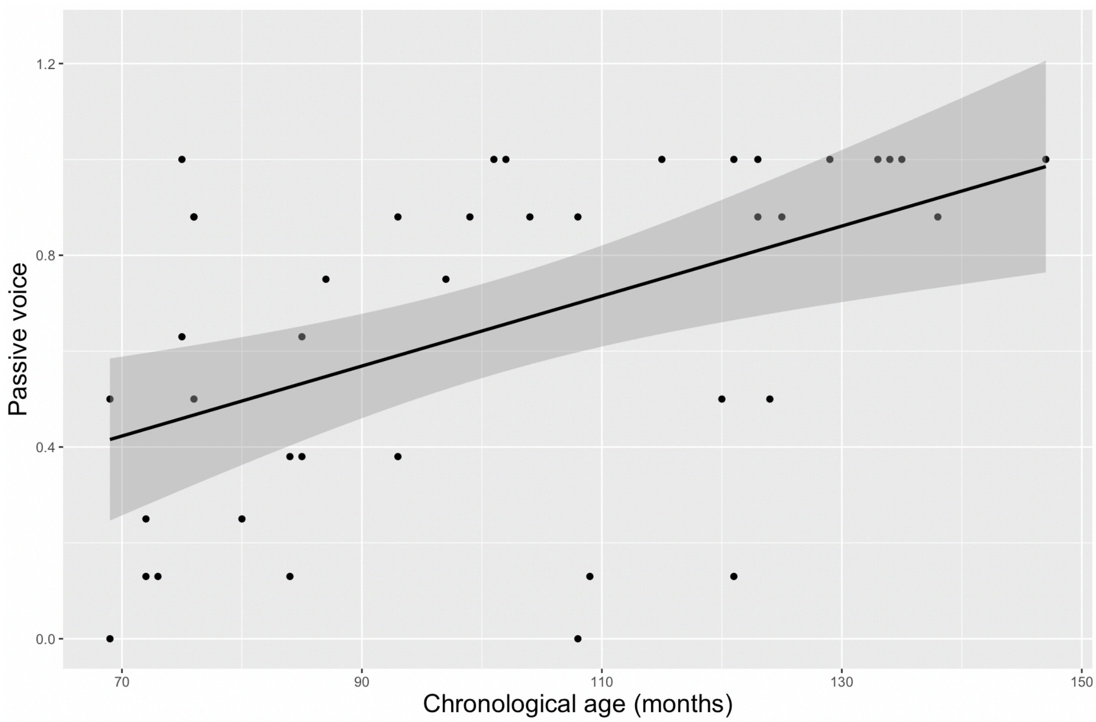

Figure 5.12 Interpretation of passive voice by CHRONOLOGICAL AGE

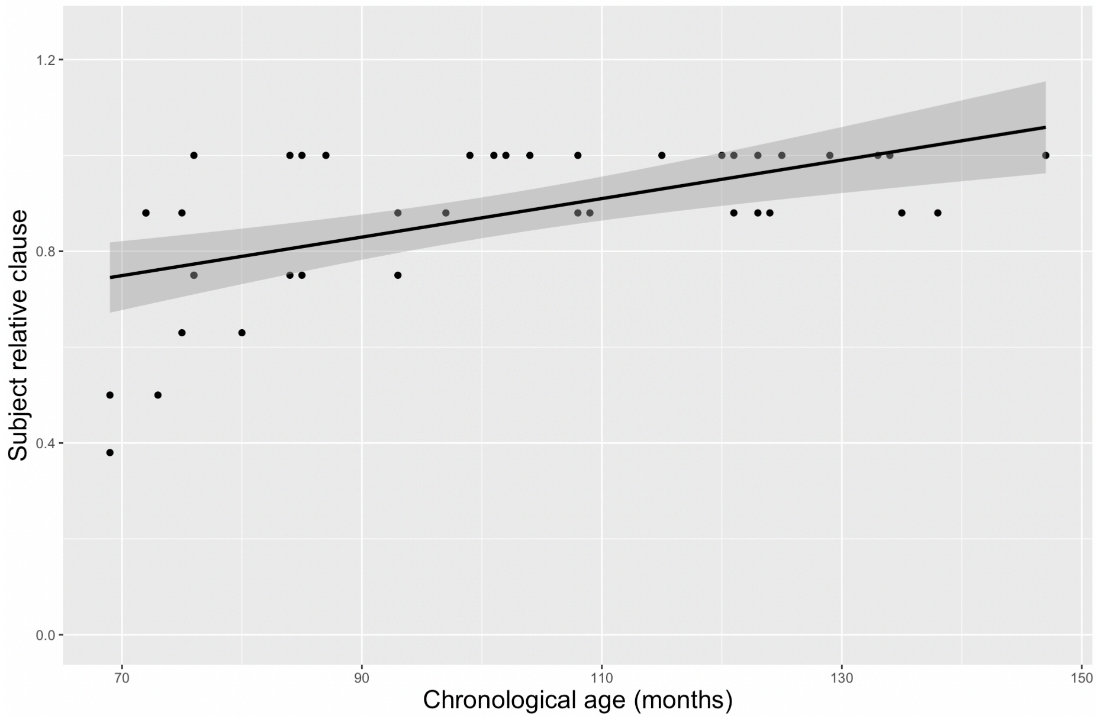

Figure 5.13 Interpretation of subject relative clauses by CHRONOLOGICAL AGE

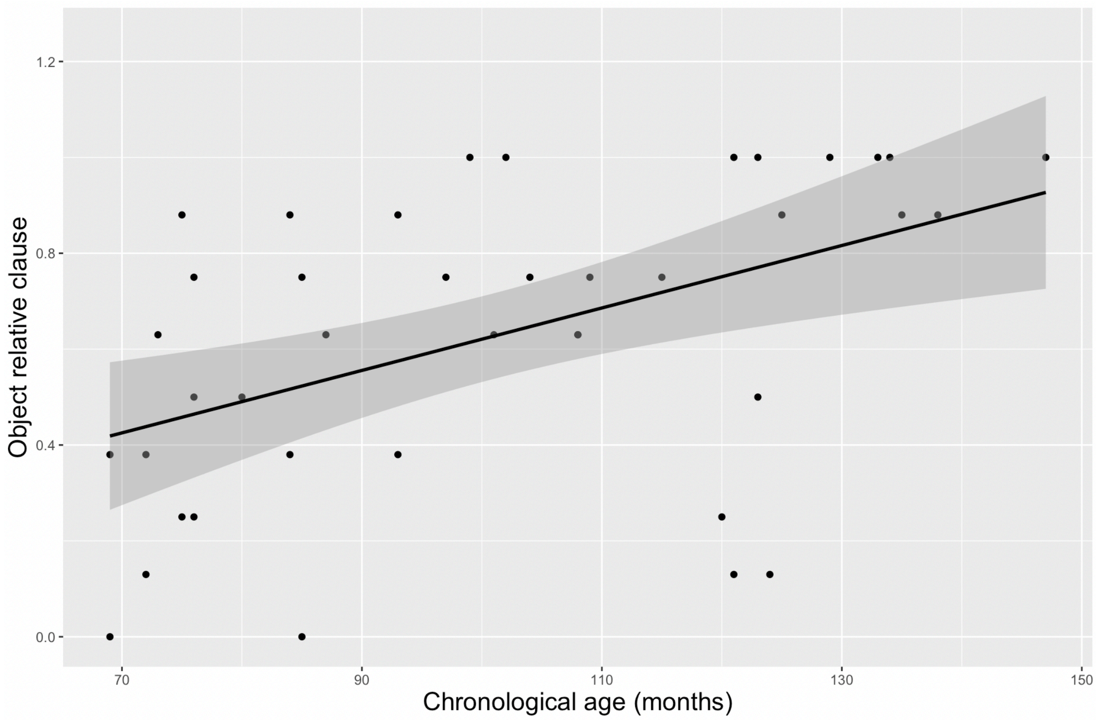

Figure 5.14 Interpretation of object relative clauses by CHRONOLOGICAL AGE

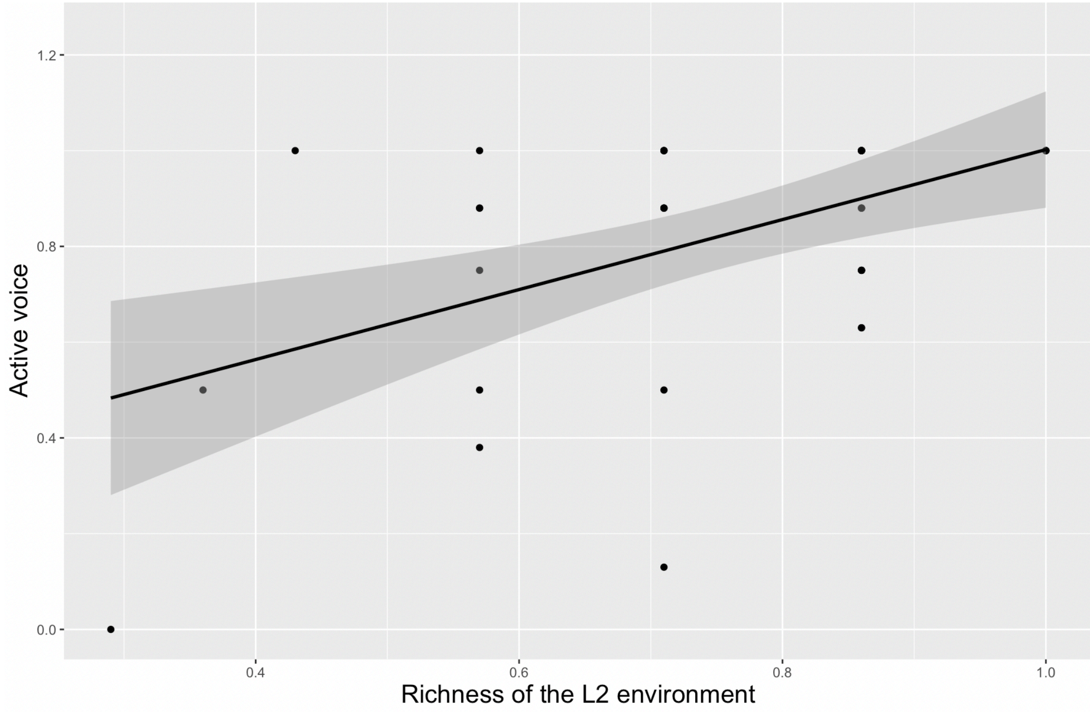

Figure 5.15 Interpretation of active voice by RICHNESS OF THE L2 ENVIRONMENT

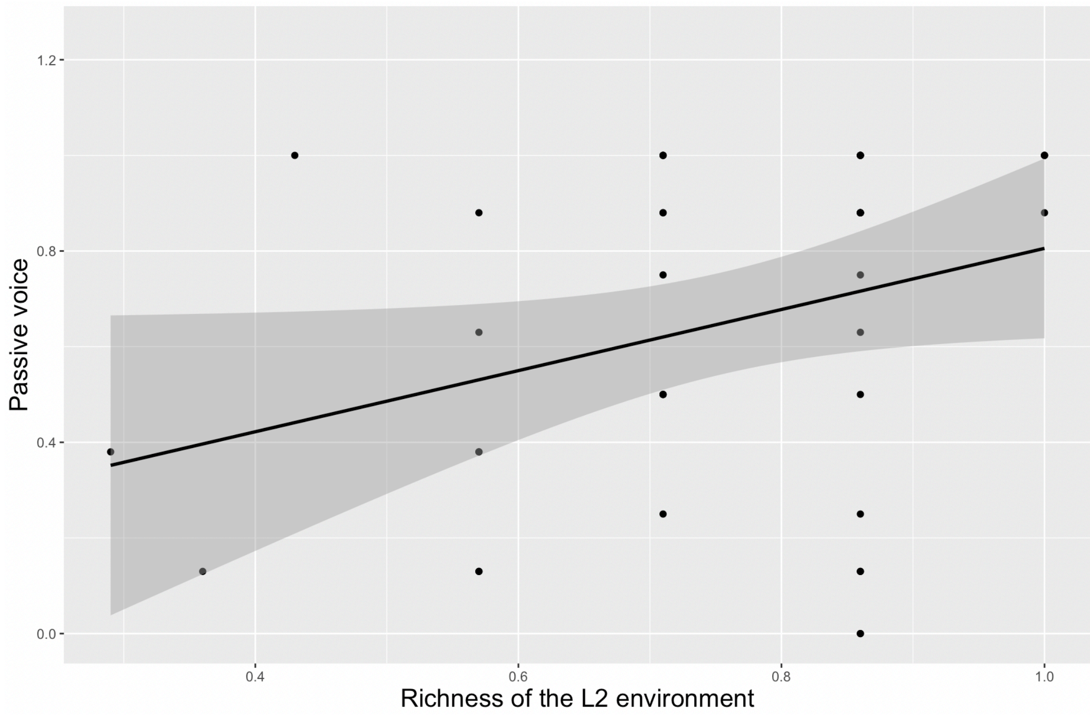

Figure 5.16 Interpretation of passive voice by RICHNESS OF THE L2 ENVIRONMENT

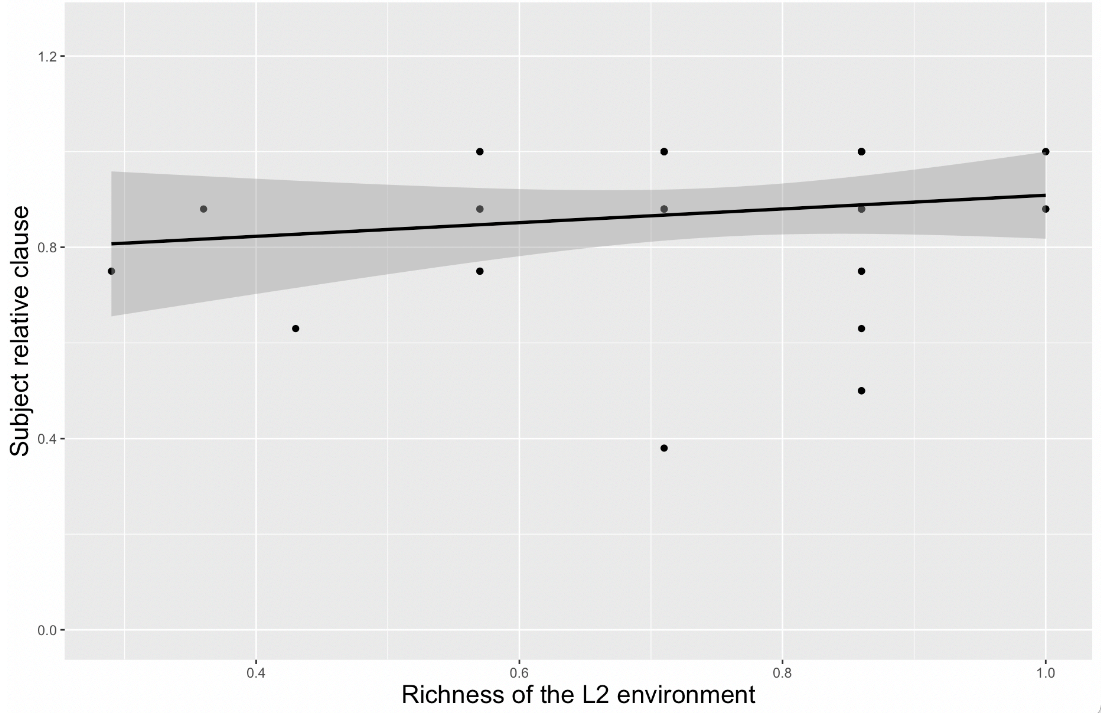

Figure 5.17 Interpretation of subject relative clauses by RICHNESS OF THE L2 ENVIRONMENT

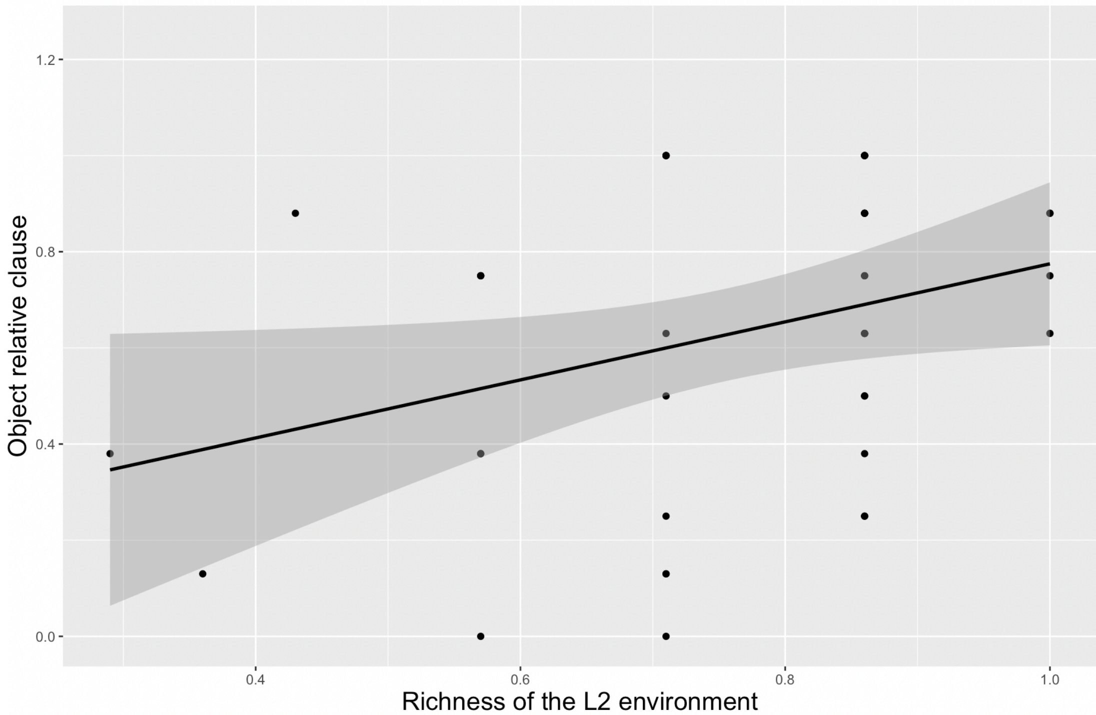

Figure 5.18 Interpretation of object relative clauses by RICHNESS OF THE L2 ENVIRONMENT

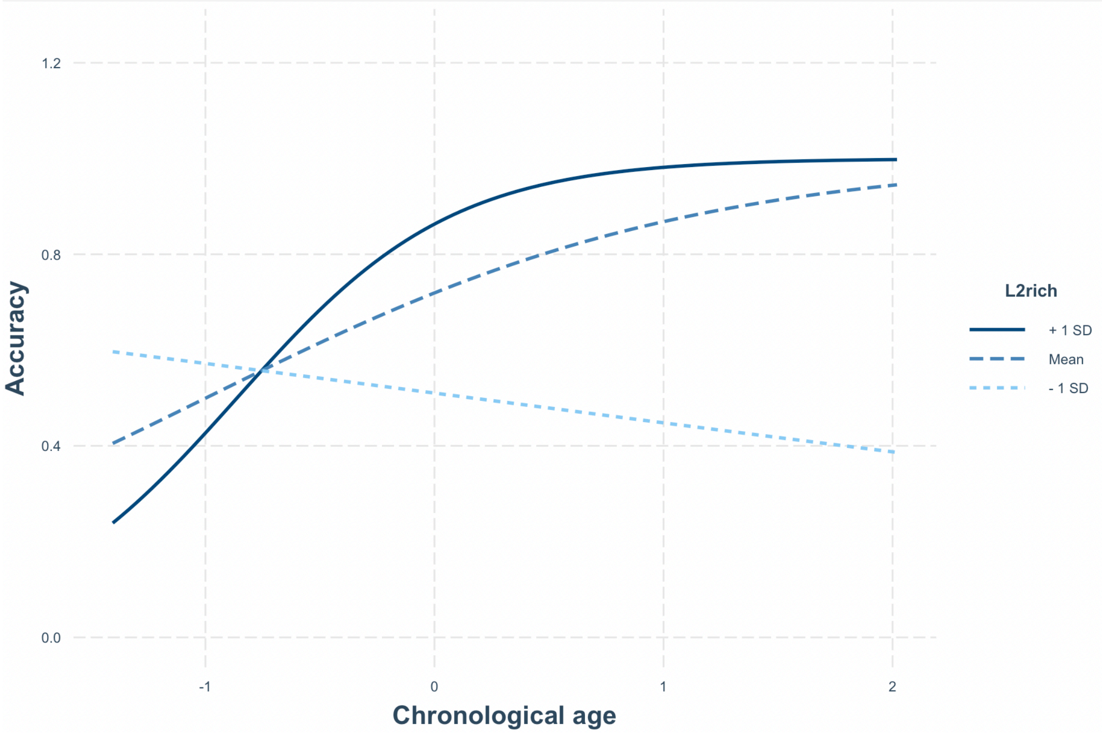

Figure 5.19 Interaction plot demonstrating interaction between CHRONOLOGICAL AGE (re-scaled x-axis) and RICHNESS OF THE L2 ENVIRONMENT for interpretation of passive voice sentences.

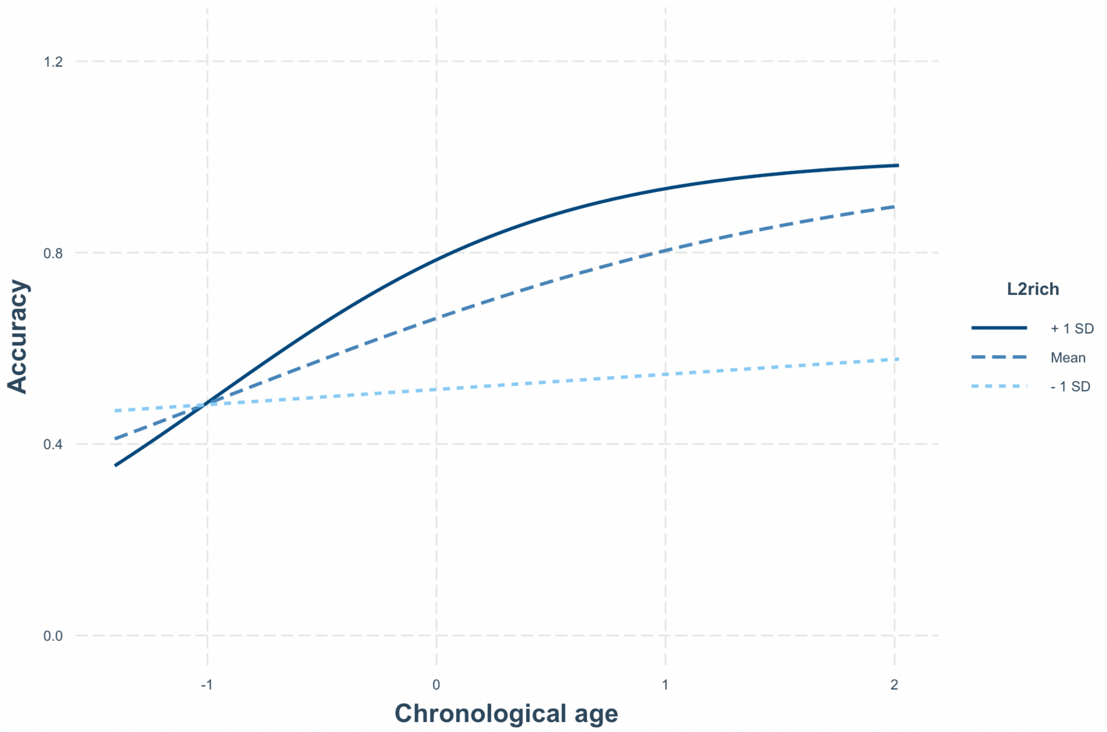

Figure 5.20 Interaction plot demonstrating interaction between CHRONOLOGICAL AGE (re-scaled x-axis) and RICHNESS OF THE L2 ENVIRONMENT for interpretation of object relative clause sentences.

The impact of chronological age on interpretation of sentence structures supports previous research which has found an effect for this factor on interpretation of syntax (e.g., Armon-Lotem et al., 2011; Bohman et al., 2010). Our finding that richness of the L2 environment impacts syntax also supports previous research which demonstrated an effect for this factor on syntactic structures, albeit for production of syntax (e.g., Paradis et al., 2017). The interaction found between chronological age, richness of the L2 environment and complexity has not been shown in previous research. However, most previous research on sequential bilingualism has not investigated the interdependencies between factors (c.f. De Cat, 2020; Sorenson-Duncan, 2017). Those which have found interdependencies have included somewhat different factors in terms in fine-grained measures of input (e.g., cumulative input – De Cat 2020; the language of maternal education – Sorenson-Duncan, 2017) which may have contributed to the diverse findings in relation to significant interdependencies.

5.4.3.2 Production of syntax and mean length of utterance in narrative storytelling

The following table (5.10) provides further information on narrative production by the bilingual children. This comprises the total number of utterances and the types and number of target embedded structures used (where applicable) by the children (as per the ENNI complexity index). This includes relative clauses, non-finite clauses, adverbial clauses and direct or indirect quotations. This table reveals that the number of utterances produced by the bilingual participants to convey the story ranged from 6 to 16 utterances. Of the target embedded and non-finite structures used, most of the participants used infinite clauses and direct or indirect quotations. In contrast, there was restrictive use of relative and adverbial clauses. A small number of participants' narrative production did not include any target embedded or non-finite clauses.

Table 5.10 Utterances and embedded and non-finite structures used in narrative production by the sequential bilingual participants

Participant number	Total number of utterances	Relative clauses	Infinite clauses	Adverbial clauses	Direct or indirect quotations
6	13	2	5		
8	13	1	2	2	
9	13		2	1	
10	13	1	3		1
11	13	1	4		2
12	13		1	2	2
19	6		2		2
20	6		2		2
21	7		1		
22	5				
23	7		2		
24	5		2	2	1
25	6				1
26	6				
27	11	1	2		
28	7				1
29	9				
30	16		6		2
31	15		4		1
32	12		2		3
33	7				
34	8				
36	9		1		1
37	11		3		1
39	7		1		

40	8				1
42	11		1	1	
43	6				
49	9		1		
55	8				
71	10		1		1
72	14		3		2
73	9				2
78	14		2		3
81	11		1		2
82	11		2		1
83	9				1
84	12		3		1
89	15		4		1
90	8				

Results of the likelihood ratio tests via the statistical analysis revealed that the removal of each predictor did not significantly reduce the fit of the model compared to the full model. The fitted model revealed that SHORT-TERM MEMORY and SOCIO-ECONOMIC STATUS predicted mean length of utterance and use of embedded clauses in narrative production (Table 5.10).

Table 5.11 Linear mixed-effects regression modelling results for the impact of factors on mean length of utterance and subordinate and non-finite clauses in narrative production.

Predictor variables	β	Z	p
Intercept	-3.612	2.856	.903
Chronological age	2.165	1.225	.081.

Length of L2 exposure	-1.645	1.270	.897
Short-term memory	2.458	1.019	.019*
Richness of the L2 environment	-1.538	1.039	.883
Socio-economic status	-3.070	1.321	.023*
Structure-narrative	2.500	1.832	1.000

.p<.1, *p<.05, **p<.01, ***p<.001

The impact of short-term memory on use of both mean length of utterance and embedded clauses in narrative production is shown by the upward slopes of effect revealing that as scores of short-term memory increased, so did the use of both language features (Figure 5.21). The graph also suggests that higher short-term memory resulted in greater use of embedded clauses (blue line) compared to mean length of utterance (pink line).

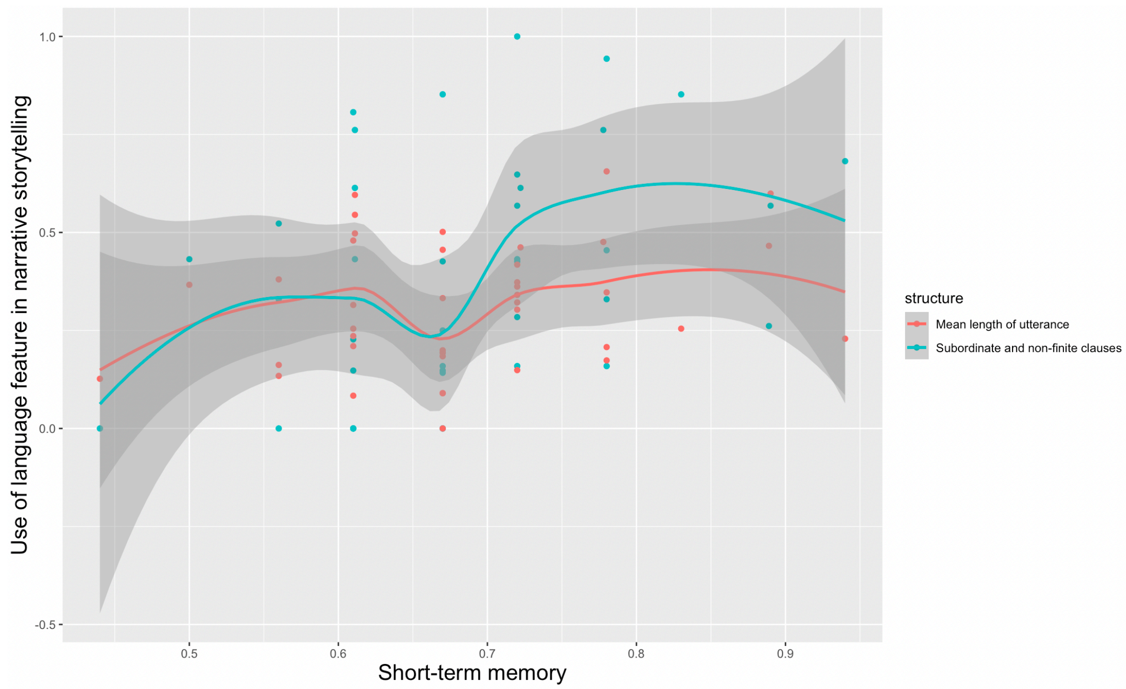

Figure 5.21 Mean length of utterance and use of subordinate and non-finite clauses in narrative production by SHORT-TERM MEMORY

For socioeconomic status, the negative beta coefficient (β=-3.070) indicates that increases in socioeconomic status resulted in significant decreases in mean length of utterance and embedded clauses in narrative production. This is illustrated in the downward slopes of effect (Figure 5.22) reflecting that participants from higher socioeconomic status backgrounds had lower mean lengths of utterance and used less embedded clauses in narrative production (had mothers with higher levels of education and higher L2 English proficiency) compared to those from lower socioeconomic backgrounds.

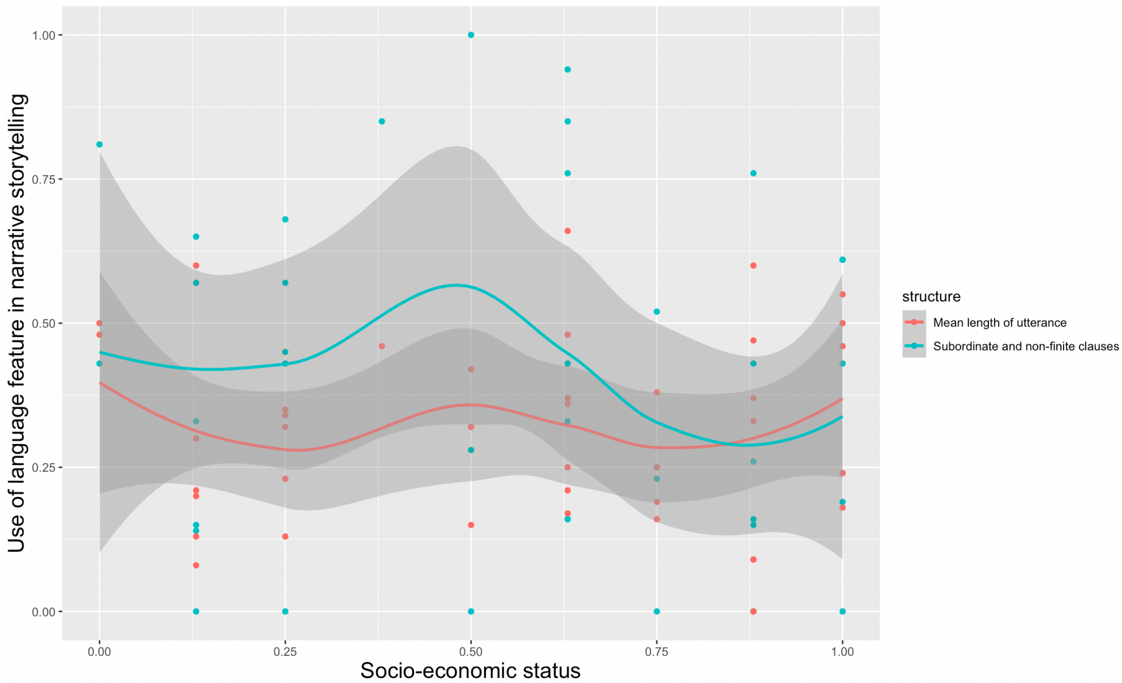

Figure 5.22 Mean length of utterance and use of subordinate and non-finite clauses in narrative production by SOCIO-ECONOMIC STATUS.

Results suggest that only short-term memory predicted higher mean length of utterance and embedded clauses in narrative production. This finding both supports and contrasts previous research (Paradis et al., 2017) which has shown that a number of factors (length of L2 exposure, richness of the L2 environment and short-term memory) predicted syntactic structures in narrative production. However, target structures were measured differently in both cases. This will be considered further in the discussion section.

5.4.5 Summary of results for the sequential bilingual participants

In relation to the study's internal factors, chronological age was shown to impact interpretation of syntax but not expressive vocabulary or morphology. The impact of chronological age on syntactic structures supports previous research (Table 5.8) and may suggest that the greater language experience (overall language experience including that from the L1) and cognitive capacities associated with an older age in childhood facilitates interpretation of sentence structures. A novel finding was that the impact of chronological age on passive voice and object relative clauses was shown to be more complex in that it depended on the child's richer L2 experiences. Older sequential bilingual children who participated in more L2 play and social activities showed greater accuracy for these structures. Therefore, when sequential bilingual children are older, participation in L2 play and social activities appears to support the proficiency of interpreting complex syntax which involves the mapping of non-canonical semantic roles and grammatical categories (as in passive voice) or when the language user encounters an intervener (as in object relative clauses). The finding for no impact of chronological age on expressive vocabulary and morphology contrasts previous research which has found an effect for this variable on these language measures (Tables 5.4, 5.6 and 5.8). Short-term memory impacted production of syntax and mean length of utterance in narrative storytelling. As discussed previously, age of L2 onset was removed from the statistical analysis as it was strongly correlated with length of L2 exposure and the Principle Component Analysis showed that this variable (age of L2 onset) accounted for a much smaller (21%) proportion of the variation in the data. Therefore, age of L2 onset was not found to be a predicting variable which both supports and contrasts previous research (Table 5.4, 5.6 and 5.8). These discrepancies between previous findings and ours is something that will be examined in detail in the discussion section.

In relation to the study's external factors, length of L2 exposure was shown to be the only predictive factor for proficiency for expressive vocabulary and third person singular and past tense morphology (measured via the TEGI task). This finding supports previous research finding an effect of language input for these measures (Tables 5.4 and 5.6). A positive effect of input was also found for interpretation of sentence structures (active and passive voice, and object relative clauses) however, this was not related to length of L2 exposure but specifically, richer L2 exposure environments (participation in L2 play and social activities). This finding supports previous research finding an impact of L2 richness for use of sentence structures (Paradis et al., 2017). Furthermore, as already mentioned, this factor appears to support greater proficiency for interpretation of complex syntax (passive voice and object relative clauses) for older sequential bilingual children.

In terms of distal external factors (i.e., those which indirectly impact individuals' input experience) which in the current study included the measure of socio-economic status (measured by way of combining the mother's educational level and self-rated L2 proficiency), was found to have no impact on any language measure. The lack of impact of socio-economic status is surprising in that this factor has previously been shown to be a robust predictor of language proficiency, especially in terms of lexical proficiency, in both L1 (e.g., Hoff et al., 2002; Hoff, 2003; Huttenlocher et al., 2002; Vasilyeva et al., 2008) and L2 (e.g., Hammer et al., 2012; Oller & Eilers, 2002) acquisition. However, these findings also support other previous findings (e.g., Paradis, 2011; Paradis et al., 2017). The impact of these factors will be examined further in the discussion chapter.

The following section will present the results from the linear regression analyses for the monolingual participants.

5.5 Linear regression results - monolingual participants

The monolingual participants were included for two reasons: as controls; and to allow a comparison of language poulations (L1 versus L2). The only predicting factors included for these participants were chronological age and short-term memory. All language measures included are as detailed for the sequential bilingual participants.

5.5.1 Lexical proficiency

For expressive vocabulary, the fitted model revealed a main effect of CHRONOLOGICAL AGE (Table 5.11). The model also revealed that SHORT-TERM MEMORY was marginally significant. When the model with the interaction was compared to the model with main effects only, no interaction effect was found ($\chi^2(1) = 0.6034$, p=.437).

Table 5.12 Impact of predictors from fitted model on lexical proficiency

Predictor variables	β	Z	p
Intercept	3.406	7.665	.001***
Chronological age	0.789	5.705	.001***
Short-term memory	0.245	1.822	.068.

.p<.1, *p<.05, **p<.01, ***p<.001

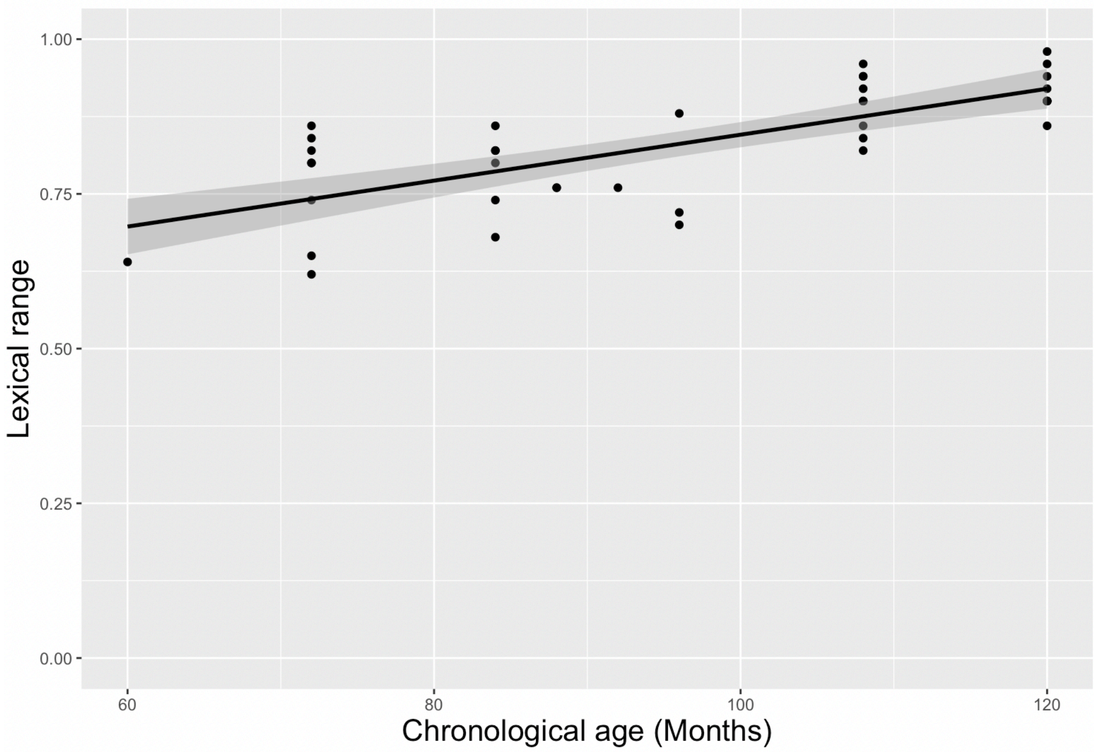

Figure 5.23 Accuracy of monolingual participants' lexical proficiency by CHRONOLOGICAL AGE

The main effect of chronological age is shown by the upward slope of effect which reflects that children at younger ages, although having generally high vocabulary scores, had lower scores compared to children at older ages who had consistently higher scores for the target vocabulary (Figure 5.23).

5.5.2 Morphology – TEGI tasks

For use of morphology, the fitted model revealed a main effect of CHRONOLOGICAL AGE (Table 5.12).

Table 5.13 Impact of predictors from fitted model on use of morphology

Predictor variables	β	Z	p
Intercept	3.449	10.508	.001***
Structure	.290	.771	.440
Chronological age	1.162	1.014	.001***
Short-term memory	-0.134	-0.617	.537

.p<.1, *p<.05, **p<.01, ***p<.001

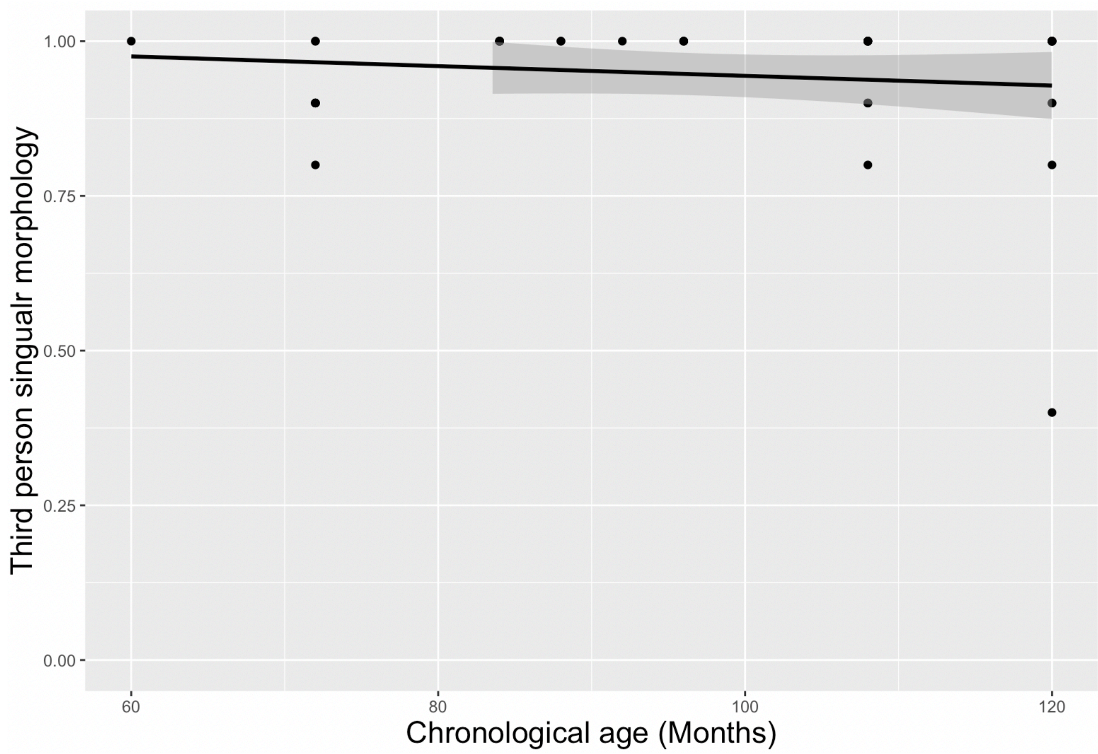

Figure 5.24 Accuracy of monolingual participants in using third person singular morphology by CHRONOLOGICAL AGE

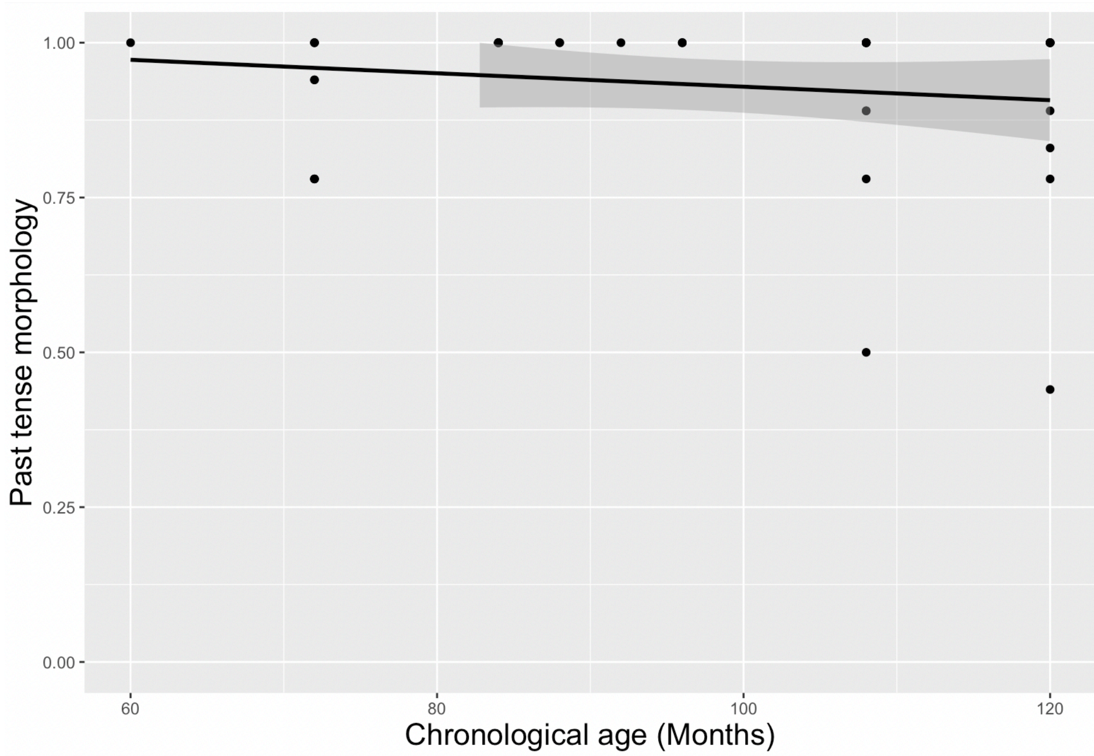

Figure 5.25 Accuracy of monolingual participants in using past tense morphology by CHRONOLOGICAL AGE

Although chronological age demonstrated a positive significant impact on third person singular and past tense morphology, the gradient line conversely reveals the opposite effect. This may be due to a small number of outliers (2 older participants) who had much lower scores than the majority of older monolingual children (Figures 5.24-5.25).

5.5.3 Interpretation of syntactic structures

For interpretation of sentence structures, all fixed effects reached significance: CHRONOLOGICAL AGE ($\chi^2(1) = 14.26$, p=<.001), SHORT-TERM MEMORY ($\chi^2(1) = 3.840$, p=.050), STRUCTURE ($\chi^2(1) = 3.824$, p=<.050), and COMPLEXITY ($\chi^2(1) = 17.96$, p=<.001). A likelihood ratio test confirmed that the model with an interaction between COMPLEXITY, STRUCTURE, CHRONOLOGICAL AGE, and SHORT-TERM MEMORY outperformed the sub-optimal model (the model with fixed effects) ($\chi^2(1) = 11.591$, p=.009), suggesting that the interaction between these factors was a significant predictor for accuracy. The final model revealed a main effect of SHORT-TERM MEMORY across all structures. A main effect of CHRONOLOGICAL AGE and COMPLEXITY was also shown however, a significant interaction between VOICE, COMPLEXITY and CHRONOLOGICAL AGE demonstrated that age specifically predicted passive voice (Table 5.13). This is shown by the upward slope of effect in Figure 5.30.

Table 5.14 Generalised linear mixed-effects regression modelling results for impact of factors on interpretation of syntactic structures.

Predictor variables	β	Z	p
Intercept	2.67	.304	.001***
Structure	.328	1.09	.272
Complexity	1.124	3.401	.001***
Chronological age	1.238	3.247	.001***
Short-term memory	.427	1.957	.050**
Structure(RC)*Complexity(high)*age	.701	3.195	.977
Structure(Voice)*Complexity(high)*age	.259	1.153	.042*
Structure(RC)*Complexity(low)*age	.701	3.195	.080.

.p<.1, *p<.05, **p<.01, ***p<.001

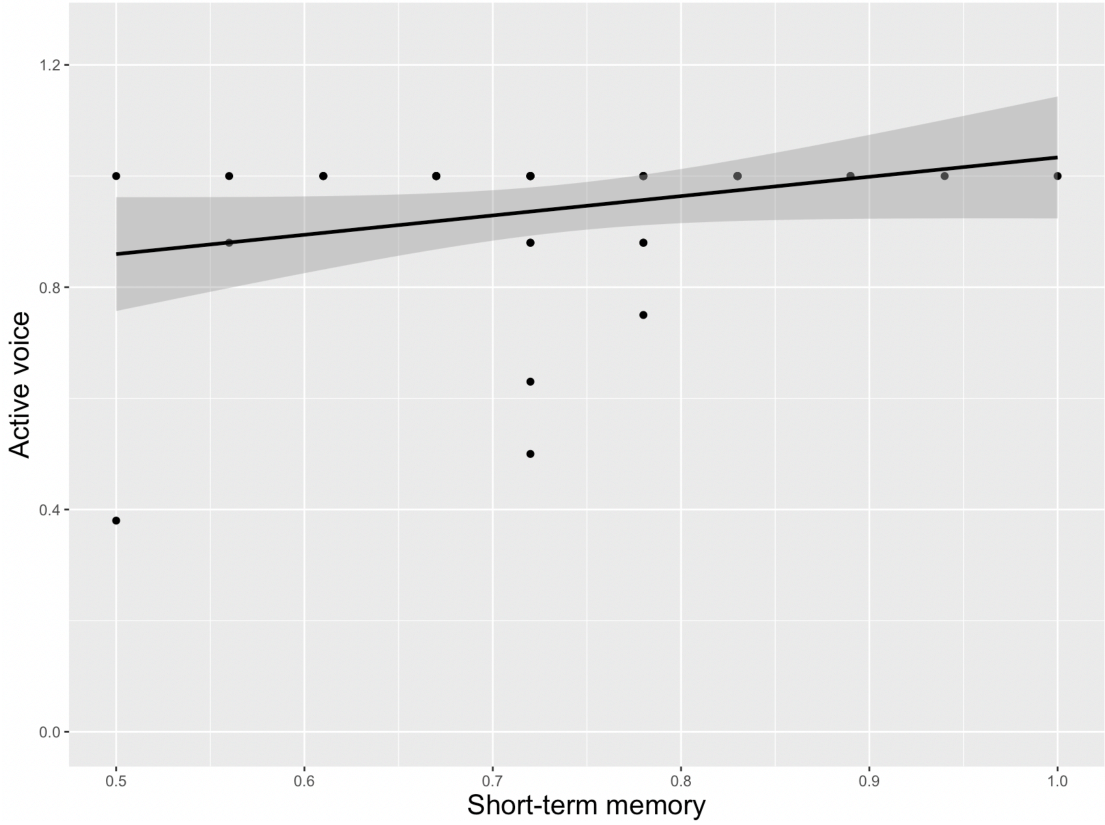

Figure 5.26 Accuracy of monolingual participants in interpreting active voice sentences by SHORT-TERM MEMORY

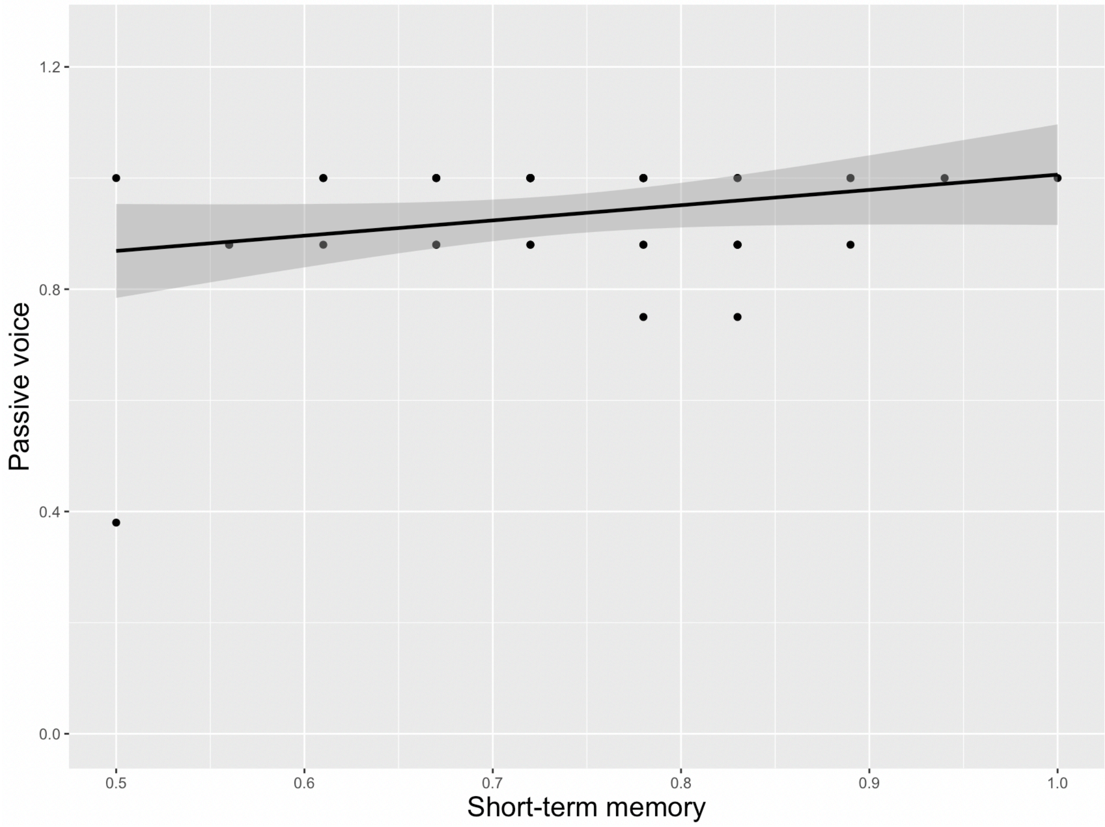

Figure 5.27 Accuracy of monolingual participants in interpreting passive voice sentences by SHORT-TERM MEMORY

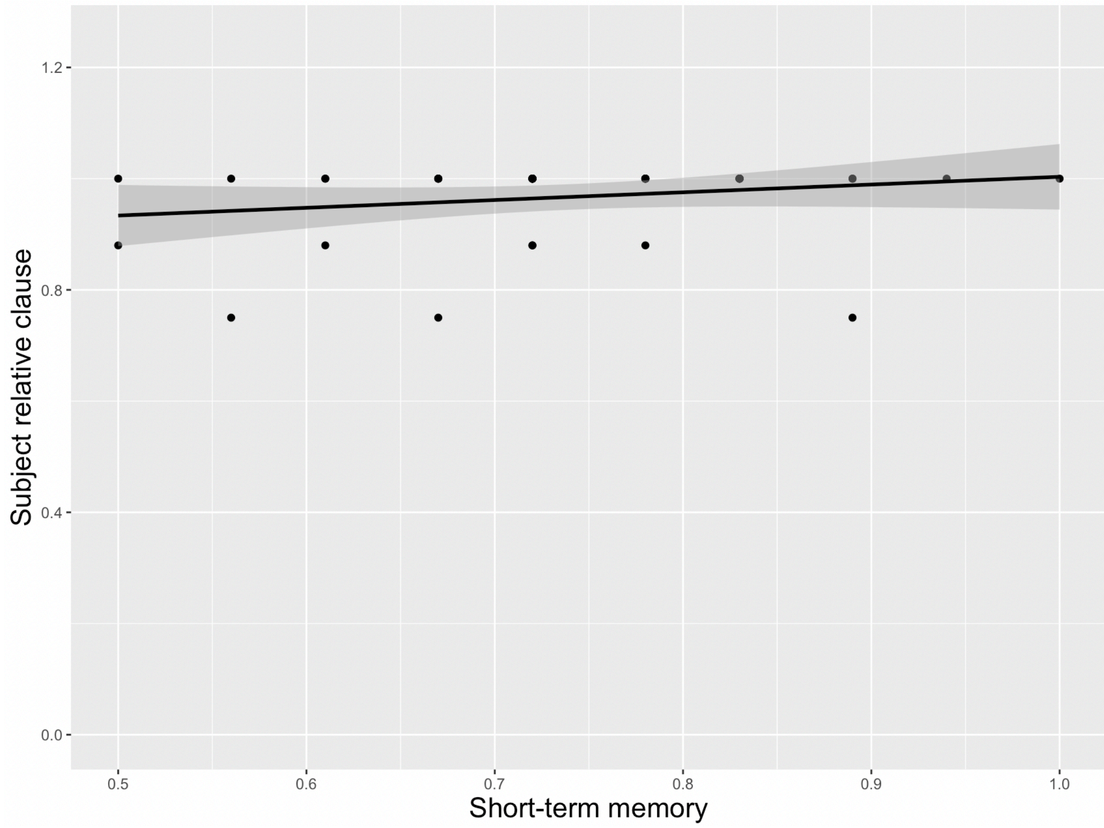

Figure 5.28 Accuracy of monolingual participants in interpreting subject relative clause sentences by SHORT-TERM MEMORY

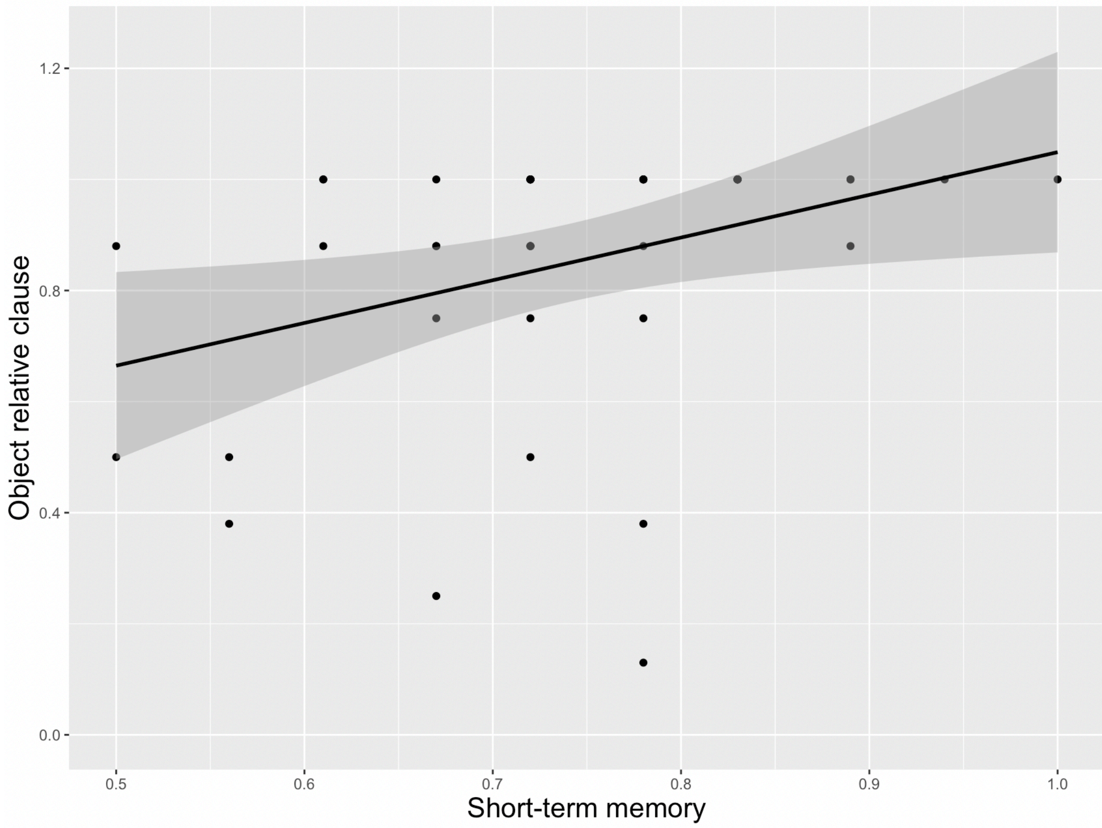

Figure 5.29 Accuracy of monolingual participants in interpreting object relative clause sentences by SHORT-TERM MEMORY

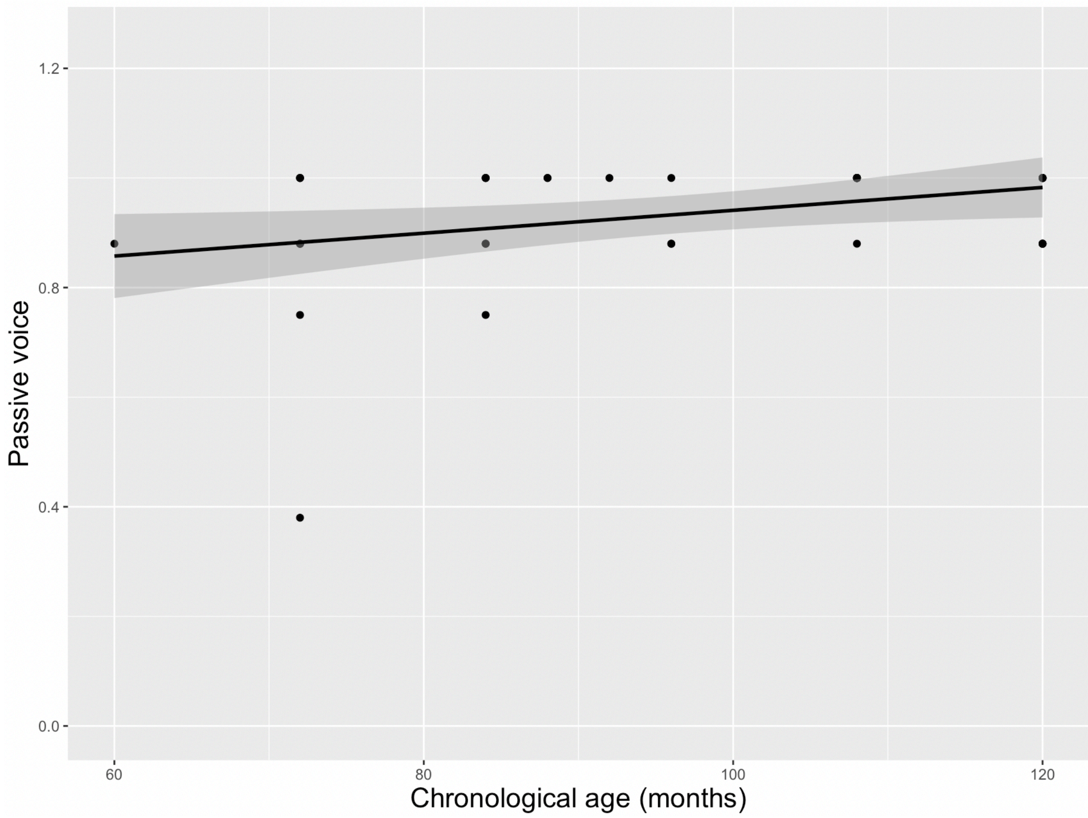

Figure 5.30 Accuracy of monolingual participants in interpreting passive voice test sentences by CHRONOLOGICAL AGE

5.5.4 Production of syntax and mean length of utterance in narrative storytelling

The following table provides further information on narrative production by the monolingual children. This comprises the total number of utterances and the types and number of target embedded and non-finite language structures used (where applicable) by the children in these utterances as per the ENNI complexity index. This includes relative clauses, non-finite clauses, adverbial clauses, gerund clauses, sentences serving as noun phrases, and direct or indirect quotations. This table reveals that the number of utterances produced by the bilingual participants to convey the story ranged from 5 to 17 utterances. Of the target embedded and non-finite structures used, most of the participants used infinite clauses and direct or indirect quotations. In contrast, there was restrictive use of other types of clauses including relative and adverbial clauses. Only one participant's narrative production did not include any target embedded or non-finite clauses.

Table 5.15 Utterances and embedded and non-finite structures used in narrative production by the monolingual participants

Participant number	Total number of utterances	Relative clause	Non-finite clause	Adverbial clauses	Direct or indirect quotation	Gerund clause	Wh-clause
1	13		5		1		
2	13	1	6				
3	13	1	4	1	1		
4	13		2				
5	13		4		1		
7	13		4		1		
13	13	2	3		1		
14	13		3		1		
15	13		1		1	1	
16	13		7	2	5	1	
17	13		4		2		
18	5		1				
45	17	1	5				
46	8		4		2		
50	8		2		1		
51	15		4		1		
52	9		2		1		
53	8		2				
54	8		1				
56	8				1		
57	8		4				
58	8		2		1		
59	8	2	1		1		
60	8		6	1	1		
61	8	1	2				
62	8	1	1		1		
63	8	1	2	1	2		
64	8		4		1		

65	9	1	1		1		1
66	8		3				
67	8		4		2		
74	8						
75	8				1		
76	8	1			1		
77	5				2		
79	8						
80	8		4	1	1		
85	8		2		2		
86	8		1		1		
87	8		3		1		

In terms of the statistical analysis, likelihood ratio tests revealed that the removal of each predictor did not significantly reduce the fit of the model compared to the full model. The final model revealed that CHRONOLOGICAL AGE predicted accuracy across the target language features (mean length of utterance and use of embedded clauses in narrative production) (Table 5.14).

Table 5.16 Linear mixed-effects regression modelling results for impact of factors on mean length of utterance in narrative production.

Predictor variables	β	Z	p
Intercept	-.122	.205	.564
Chronological age	.255	.123	.042.
Short-term memory	-0.001	.116	.991
Structure-narrative	-0.001	.213	.998

.p<.1, *p<.05, **p<.01, ***p<.001

The impact of chronological age on mean length of utterance and embedded clauses in narrative production for the monolingual participants is shown by the upward slopes of effect for mean length of utterance (pink line) and subordinate and non-finite clauses (blue line) (after 100 months of age; Figure 5.31). This suggests that monolingual children at older ages had higher mean lengths of utterance and use of embedded clauses compared to children at younger ages.

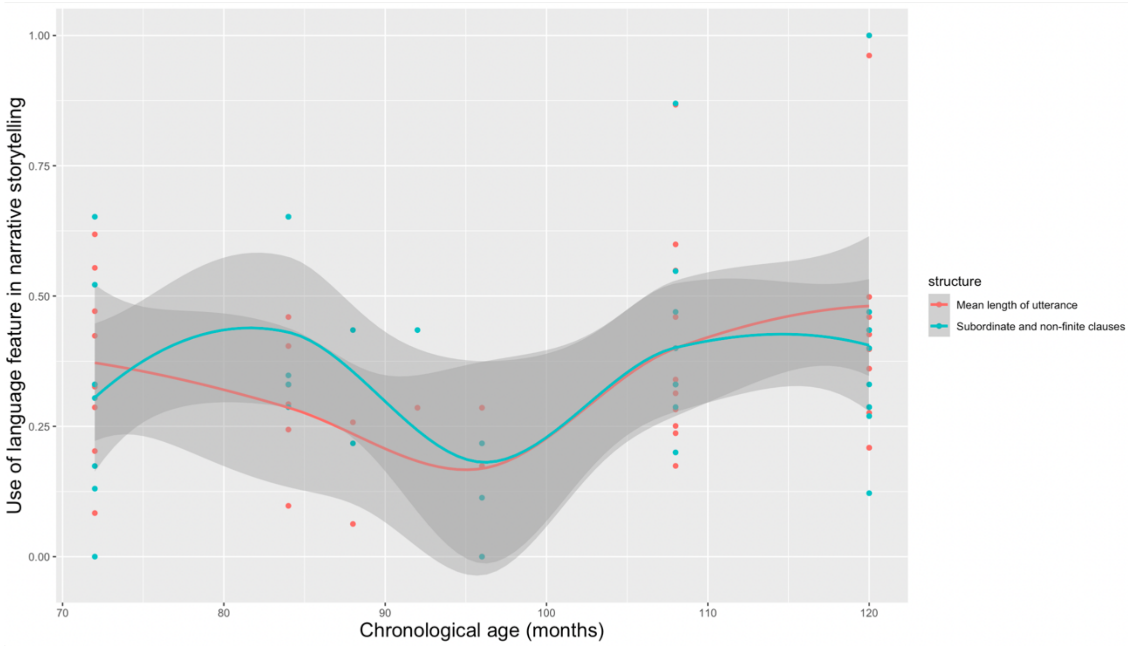

Figure 5.31 Mean length of utterance and use of subordinate and non-finite clauses in narrative production by CHRONOLOGICAL AGE

5.5.5 Summary of results for monolingual participants

For the monolingual participants, chronological age predicted expressive vocabulary and third person singular and past tense morphology (measured via the TEGI task), interpretation of passive voice sentences, and mean length of utterance and embedded clauses in narrative production. Short-term memory predicted proficiency in interpretation of all target sentence structures (active and passive voice and subject and object relative clauses).

5.6 Comparison of bilingual and monolingual results

As mentioned previously, predictors included a number of factors for the sequential bilingual participants but only chronological age and short-term memory for the monolingual participants. In taking stock of the above results to compare between the bilingual and monolingual participants (Table 5.15), this reveals a number of contrasting findings. Chronological age predicted lexical and morphological (third person singular and past tense in the TEGI task) proficiency for the monolinguals while length of L2 exposure predicted the same language features for the bilinguals. For interpretation of sentence structures for the monolinguals, short-term memory predicted all sentences and chronological age specifically predicted passive voice. Chronological age predicted interpretation of all sentences (active and passive voice and relative clauses) for the bilinguals, with those at older ages and with richer L2 play and social activities, having greater accuracy with passive voice and object relative clauses. Conversely, chronological age predicted mean length of utterance and embedded clauses in narrative production for the monolinguals, while short-term memory predicted these language features for the bilinguals.

Table 5.17 A comparison of predicting factors for each language measure for bilingual and monolingual participants

Language measure	Predicting factors for each language group	
	Bilingual participants	Monolingual participants
Expressive lexical range	• Length of L2 exposure	• Chronological age
Use of third person singular	• Length of L2 exposure	• Chronological age
Use of past tense	• Length of L2 exposure	• Chronological age
Interpretation of active voice	• Chronological age • Richness of the L2 environment (greater	• Short-term memory

	participation in L2 play and social activities)	
Interpretation of passive voice	• Interaction: older chronological age and richer L2 experiences (greater participation in L2 play and social activities) – higher proficiency for older children participating in richer L2 environments	• Chronological age • Short-term memory
Interpretation of subject relative clauses	• Chronological age • Richness of the L2 environment (greater participation in L2 play and social activities)	• Short-term memory
Interpretation of object relative clauses	• Interaction: older chronological age and richer L2 experiences (greater participation in L2 play and social activities) – higher proficiency for older children participating in richer L2 environments	• Short-term memory
Mean length of utterance in narrative production	• Short-term memory	• Chronological age
Use of embedded clauses in narrative production	• Short-term memory	• Chronological age

5.7 Chapter summary

This chapter presented the findings from linear regression analyses which have shown that various internal and external individual difference factors are involved in predicting the proficiency of English language measures for sequential bilingual children acquiring English as an L2 and for monolingual children.

For the sequential bilingual participants, results suggested that length of L2 exposure predicted expressive lexical and morphological (third person singular and past tense accuracy in the TEGI task) proficiency. Results also suggested that chronological age and richness of the L2 environment predicted interpretation of sentence structures (active and passive voice and subject and object relative clauses). An interaction was found between chronological age and richness of the L2 environment for interpretation of passive voice and object relative clauses suggesting that bilingual children at older ages who also had greater participation in play and social activities, were more accurate in interpreting these complex structures. Results also suggested that short-term memory predicted mean length of utterance and embedded clauses in narrative production. In contrast, higher socioeconomic status did not predict proficiency of any language measure.

For the monolingual participants, results suggested that chronological age predicted lexical and morphological (third person singular and past tense accuracy in the TEGI task) proficiency, mean length of utterance and use of embedded clauses in narrative production, and interpretation of passive voice. Results also suggested that short-term memory predicted interpretation of all sentence structures.

Many outcomes reflect previous research findings investigating the effects of individual difference factors on L2 proficiency for the sequential bilingual children. However, the inclusion of individual measures which were complex and non-complex provided further insights on the impact of these factors on specific morphosyntactic structures as well as novel findings on how predictors interact to impact linguistic proficiency.

6. Discussion

6.1 Introduction

This project investigated the impact of individual difference factors in predicting the proficiency of language measures which were both complex and non-complex in sequential bilingual acquisition in childhood. This linguistic population has been shown to be affected by a number of different factors which are both internal (e.g., age and cognitive effects) and external (e.g., environmental effects) to the individual. Previous research has revealed mixed findings across domains in relation to the impact of these factors on the language proficiency of this population and it is these mixed findings that have served as the motivation for this study (e.g., Armon-Lotem et al., 2011; Bedore et al., 2016; Blom & Bosma, 2016; Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; De Cat, 2020; Jia and Fuse; 2007; Nishikawa, 2014; Paradis, 2011; Paradis et al., 2017; Paradis & Blom, 2016; Roesch & Chondrogianni, 2016; Rothman et al., 2018; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978; Unsworth, 2016).

The current study is unique in that it aimed to measure not only the impact of a number of individual difference factors, but also the interdependencies between these factors on various specific language measures which were both complex and non-complex using a novel experimental task and standardised tests. Chapter 3 discusses the issue of complexity. Complex language features in this study are defined as those which involve irregularity (e.g., past tense versus third person singular morphology), non-canonical word order (e.g., passive versus active voice), and intervening elements (e.g., object versus subject relative clauses). The following language measures were investigated in the present study: interpretation of active and passive voice and subject and object relative clause sentences, measured by way of an experimental colouring task; expressive use of third person singular and past tense morphology, and lexical range, measured via standardised tests; and expressive morphosyntax measured via mean length of utterance and embedded clauses in narrative storytelling.

The target individual difference factors for the sequential bilingual children were chronological age, age of L2 onset, short-term memory, motivation for learning the L2, richness of the L2 environment (play and social activities in the L2), L2 use at home (to and from the child in relation to siblings and adults at home), L2 use at school (with teachers and school peers), maternal education and maternal L2 proficiency. As highlighted in the results chapter, following initial analyses of the data including a correlation analysis and a Principle Component Analysis, some factors were dropped or combined to create new factors. Therefore, the final individual difference factors for the bilingual participants were chronological age, short-term memory, length of L2 exposure, richness of the L2 environment and socioeconomic status. Individual difference factors in relation to the age-matched monolingual controls were chronological age and short-term memory.

This chapter includes a discussion of the current study's major findings to help answer the following research questions:

1. How do internal and external factors affect proficiency of complex and non-complex language features in sequential bilingualism?
2. Are there interdependencies between predicting factors for the target language measures?
3. Are there differences between the sequential bilingual and monolingual participant groups in terms of the impact of predicting factors on language?[33]

The statistical analysis revealed the following key findings.

Sequential bilingual participants:

- Length of L2 exposure predicted use of vocabulary and morphology (measured via the TEGI task).
- Chronological age predicted comprehension of complex and non-complex sentence structures (active and passive voice and subject and object relative clauses).
- Richness of the L2 environment (play and social activities in the L2) predicted comprehension of complex and non-complex sentence structures (active and passive voice and subject and object relative clauses).
- Chronological age and richness of the L2 environment interacted and revealed that older bilingual children who participated more in L2 play and

[33] Not all factors are relevant for monolingual learners so this question will focus only on those that can be applied to both populations.

social activities had much higher accuracy for interpretation of more complex sentences (passive voice and object relative clauses).

- Socio-economic status (maternal education and maternal L2 proficiency) and short-term memory predicted mean length of utterance and embedded clauses in narrative production.

Monolingual participants:

- Chronological age predicted use of vocabulary, morphology (measured via the TEGI task), mean length of utterance and embedded clauses in narrative production, and comprehension of passive voice.
- Short-term memory predicted comprehension of complex and non-complex sentence structures.

The following sections will discuss the interpretation, limitations, and future research possibilities in relation to these key findings. This discussion will show that an older age in childhood, which is associated with greater cognitive ability and overall language experience, predicts proficiency of different language features depending on the language population under consideration. As above, for the sequential bilingual children this predicts interpretation of syntax (active and passive voice and subject and object relative clauses), and for the monolingual children it predicts (mostly) expressive morphosyntax (mean length of utterance and embedded clauses in narrative storytelling) alongside interpretation of passive voice. Similarly, short-term memory also predicts different language measures depending on language group. For the bilingual children, this factor predicts expressive morphosyntax and for the monolinguals it predicts interpretation of syntax. These results suggest differences in how language is processed in bilingual and monolingual acquisition in childhood and possibly the impact of being at overall particular stages of acquisition of the language.[34] The younger ages of onset of participants in the current study do not predict any language measure which counters the view that 'younger is better' in language acquisition. In terms of external factors, results suggest a length of

[34] Overall, the monolingual children appear to be at a more advanced stage of English language development compared to the bilingual children. This is shown be their higher mean scores for all language measures. Nevertheless, on reviewing the individual scores, it is the case that some individual bilingual children had caught up and surpassed some of the monolingual children.

exposure effect for the sequential bilinguals in relation to expressive lexical and morphological (third person singular and past tense measured via the TEGI task) proficiency. The impact of exposure on these language features may also be extended to the monolingual participants as shown by way of a chronological age effect. Results reveal that exposure through play and social activities, likely involving native-speaking peers, predicts interpretation of complex and less complex language features (e.g., active and passive voice, and relative clauses) in sequential bilingual acquisition. Additionally, language exposure through play and social activities supports proficiency of complex syntactic structures (passive voice and object relative clauses) when children are older. These findings reveal that qualitative input is an important factor for interpretation of sentence structures in sequential bilingual acquisition. The distal input measure of socio-economic status (combined maternal education and maternal L2 proficiency) did not predict any measure in sequential bilingual acquisition. However, it may be the case that this factor requires a more nuanced approach in how it is measured in the case of refugee or immigrant populations as well as more variation across scores for maternal education and maternal L2 proficiency to find an effect for this factor. Use of the target language at home does not predict any measure likely indicating a negligible influence on language proficiency from non-native speakers. Measures of L2 English language use at school and motivation for learning L2 English were too broad to capture any impact and therefore more fine-grained measures for these factors would be needed to understand their effect.

This study builds on previous research investigating individual differences in sequential bilingualism (e.g., Armon-Lotem et al., 2011; Bedore et al., 2016; Blom & Bosma, 2016; Blom & Paradis, 2015; Chondrogianni & Marinis, 2011; De Cat, 2020; Jia and Fuse; 2007; Nishikawa, 2014; Paradis, 2011; Paradis et al., 2017; Paradis & Blom, 2016; Roesch & Chondrogianni, 2016;; Rothman et al., 2018; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978; Unsworth, 2016) by providing further insights on the effect of these factors on specific language measures which are complex and non-complex, their impact on different language populations (monolingual and bilingual), as well as novel findings on how predictors interact to impact language proficiency.

6.2 Internal factors

The following sections detail the results of the target internal factors: chronological age; short-term memory; age of L2 onset; and motivation.

6.2.1 Chronological age

Chronological age in the current study was determined by measuring the participants' age at time of testing. Results revealed that chronological age predicted interpretation and use of a number of language features. For the bilingual children, this involved interpretation of both complex and less complex sentences including active and passive voice and subject and object relative clauses. For the monolingual children, chronological age predicted interpretation of passive voice only, and in contrast to the bilinguals, predicted all expressive language measures including vocabulary, morphology, and mean length of utterance and embedded clauses in narrative storytelling.

Chronological age in childhood is characterised by a continual increase in cognitive mechanisms such as memory, attention, theory of mind, reasoning, and executive functioning skills including organising, planning and monitoring of information (Cummins, 1981; Gathercole & Baddeley, 1993; Newport, 1990; Schneider et al., 2006). In addition, chronological age is associated with more well-established linguistic knowledge and processing routines through greater experience with the first language (Paradis, 2007; Schwartz, 2004a). These circumstances result in older children having substantially greater development of cognitive and linguistic skills in comparison to younger children. In relation to the bilingual children in the current study, our results suggest that these characteristics associated with older ages in childhood may be supporting their comprehension of syntactic structures. In addition, it was observed that slopes of effect revealed greater differences in accuracy between the younger and older children for the more complex structures (passive voice and object relative clauses) compared to the less complex structures (active voice and subject relative clauses) (Figures 5.14-5.18). This suggests that older chronological age compared to younger chronological age resulted in greater accuracy for the more complex structures namely those which involved non-canonical word order (passive voice) and interveners (object relative clauses). In these cases, the language features involve more complex syntactic relations in comparison to language features with simpler syntactic relations (e.g., canonical, no interveners) (Bowerman, 1979; Wiechmann, 2015; Yamaguchi, 2013).[35] The increased parsing load resulting from attempting to accurately interpretate these more complex features, likely increases the cognitive cost the language user experiences. The greater burden which may occur when interpreting these more complex language features may result in participants with more experience with language or overall cognitive ability (those at older ages) being more proficient in interpretating these features. Therefore, our results suggest that the greater cognitive and linguistic maturity associated with an older age in childhood allows the more sophisticated processing required for complex linguistic features which results in more accurate interpretation of these language features.

Another aspect to consider in relation to these findings for chronological age is the impact of socio-cultural experiences at different ages and its influence on language acquisition both in and outside the classroom. Older children, on account of being in later stages of primary school, may have access to more sentence structures (both complex and non-complex) delivered through the educational curriculum. The current study did not include any measures of the content of participants' school curriculums. Therefore, it is unknown whether older children in the study were exposed to substantially more sentence structures through their schooling. In addition, by virtue of being somewhat more independent, older children may have less restrictions in terms of where they can go and therefore engage more with activities outside of school. This conceivably may afford them greater access to richer second language experiences and opportunities to use and support their second language competence which may include more sentence structures (Jia & Aaronson, 2003). However, a correlation analysis between richness of the L2 environment (which included participation in L2 play and social activities) and chronological age did not demonstrate a strong relationship (r=.176) for the bilingual children. This suggests that, in the current study, older ages in childhood do not necessarily equate to richer second language experiences. However, as we will see later, richness of the L2 environment interacts with chronological age revealing that older bilingual

[35] In relation to intervening constituents, these are considered to be more complex as the language user must process an intervening noun phrase between the head noun and the argument's original position (the complement of the verb). In relation to non-canonical word order, these structures often involve a reinterpretation in mapping the non-canonical semantic roles to their respective grammatical categories for the correct interpretation (Ferreira, 2003).

children who have richer L2 experiences, have much higher accuracy with more complex syntactic structures. This will be discussed in more detail later in the chapter.

A further perspective to consider for the bilingual participants is that with older chronological age comes more well-established linguistic knowledge and processing routines from the first language. This could provide either an advantage or disadvantage in processing language constructs in the L2. If language features of the L1 and L2 are similar, this may advantage the older sequential bilingual children with greater L1 linguistic knowledge. Conversely, another view on the influence of age and prior linguistic knowledge is that the more advanced the knowledge of the L1, and the more entrenched the language representations are, the greater the difficulties individuals may have in reorganising these structures in accordance with the L2 (Carroll & Lambert 2003). Therefore, in this case, the younger sequential bilingual child with less established knowledge of L1 structures may have less difficulties in restructuring the L2 grammar compared to the older sequential bilingual child. A detailed examination of the impact of influence from the first language was not included in the current study. However, the impact of similar structural typology will be considered later in the chapter as well as the incorporation of this measure and what this might involve in future research (6.5).

In relation to the bilingual participants, chronological age predicted language measures within the syntactic domain as opposed to the lexical or morphological domain. This suggests that the characteristics associated with older ages in childhood, as discussed above, may be more important factors for acquisition of syntax as opposed to lexical and morphological proficiency for bilingual children. This result contrasts previous research which has shown an impact of chronological age for lexical and morphological proficiency for sequential bilingual children (e.g., Paradis, 2011; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978). However, in previous studies grammaticality probes were also included in the lexical and morphological scores alongside expressive tasks for these language measures. The current study used production tasks only therefore, it may be the case that this task type has not fully reflected the bilingual children's knowledge of lexical and morphological features in the same way as the previous studies. Assessing the participants' understanding of vocabulary and morphology through grammaticality judgment probes would provide further insight on children's proficiency of these measures. Furthermore, this inclusion of interpretative lexical and morphological proficiency would also shed more light on whether delineations between comprehension and production, which were revealed for syntax, also extends to these domains. This is considered later in relation to future research directions (6.5).

As just mentioned, while chronological age predicted syntax as opposed to vocabulary or morphology, it also specifically predicted interpretation versus production of syntax. This suggests that the characteristics associated with older ages in childhood, as discussed above, may be a more important factor for interpretation rather than production of syntax in L2 acquisition in childhood. The current study's findings on chronological age support previous research which has shown that an older age in childhood is facilitative for the comprehension of sentence structures in sequential bilingual acquisition (e.g., Armon-Lotem et al., 2011). However, it also contrasts previous research which has found an age effect for production of syntactic structures (e.g., Paradis et al., 2017). This previous study included somewhat different measures of expressive syntactic structures in narratives compared to the current study which may have resulted in the divergent findings. Whereas the previous research measured use of complement, coordinate, adverbial and relative clauses and ambiguous sentences in narrative production, the current study involved measuring use of subordinate and non-finite clauses.

Another aspect to consider in relation to age and the bilingual participants is the relationship this factor often reveals with other time-related variables (e.g., age of L2 onset and length of L2 exposure). Therefore, while chronological age predicted a number of language features for the bilingual participants, its impact may be reflecting the interconnection with other factors such as age of L2 onset and length of L2 exposure (Stevens, 2006). However, in the current study, the correlation analysis revealed that chronological age had a low correlation with both age of L2 onset ($r=.47$) and length of L2 exposure ($r=.35$) (Calkins, 2005). This suggests that, in the current study, the results we observe for chronological age are not strongly influenced by other time-related factors.

While chronological age predicted interpretation of sentences for the bilinguals, in contrast, and with the exception of interpretation of passive voice, it predicted all expressive language features for the monolinguals. This included lexical and morphological proficiency and mean length of utterance and embedded clauses in narrative production. Therefore, despite the children being age matched and conceivably having similar cognitive abilities at an older age, this factor did not predict the same language features for the bilingual and monolingual groups. This could suggest differences in the language acquisition between the two groups possibly related to how language is processed by each language population or the different overall stages of development each group are at in the acquisition of English. The following will consider each of the language domains chronological age predicted for the monolinguals and discuss differences with the bilingual group.

Chronological age predicted lexical and morphological proficiency for the monolingual children. This suggests that older monolingual children are able to utilise the conceivably greater cognitive capacity and language experience associated with older age, to better facilitate recall of lexical items and morphological features. However, while chronological age predicted expressive vocabulary and morphology for the monolingual participants, this could however, reflect a length of exposure effect. For instance, chronological age for the monolinguals could also be interpreted as a proxy for their length of exposure to English: the older the age of monolinguals, the longer overall exposure time they will have had to English. This would in fact reflect the finding for the bilinguals showing that length of exposure to English predicted vocabulary and morphology. However, it may be difficult, if not impossible, to disentangle the impact of chronological age and length of exposure for the monolingual cohort.

Chronological age also predicted interpretation of passive voice for the monolinguals reflecting that the older monolingual children were more accurate in comprehending this structure compared to the younger monolingual children. This finding supports previous research from L1 acquisition which has found that difficulties with the passive can persist until 7 years of age (e.g., Bever 1970; Brown, 1973; Borer & Wexler 1987; Chang, 1986; de Villiers & de Villiers 1985; Fox et al.,1995; Gavarró & Parramon, 2011; Horgan 1978; Maratsos et al. 1985; Meints 1999; Orfitelli 2012). Chronological age did not predict interpretation of any other target sentence structure. This may suggest that for this language group, the characteristics associated with older age specifically facilitate interpretation of passive voice as opposed to interpretation of the other complex sentences, namely, relative clauses. Early research on children's acquisition of relative clauses found that children appeared to begin to produce relative clause structures as early as 3 years old (e.g. Berman, 1997; Crain et al., 1990; de Villiers et al., 1994; Labelle, 1990, 1996; Limber, 1973; McKee & McDaniel, 2001; McKee et al., 1998; Varlokosta & Armon-Lotem, 1998; Varlokosta & Crain, 1997) although comprehension of relative clauses can cause difficulties up to age 5 (e.g. De Villers et al. 1979; Hakuta & Cohen, 1979; Sheldon, 1974; Tavakolian, 1981). This suggests that relative clause structures, albeit, simplified versions of relative clauses, are acquired earlier in L1 acquisition compared to passives. Therefore, age may have less of an impact for these sentence types. However, a surprising result is that chronological age did not predict interpretation of object extracted relative clauses for the monolinguals. This structure has been shown to cause more difficulties for children compared to subject extracted relative clauses (e.g., Friedmann et al., 2009). This is proposed to occur due to the presence of the intervening noun phase leading to greater inaccuracy (Friedmann et al., 2009). In contrast, chronological age predicted expressive embedded clauses for the monolinguals. This suggests that the characteristics associated with older ages in childhood may be more important for production, as opposed to interpretation, of embedded clauses in L1 acquisition in childhood. Furthermore, as we will see later, our results reveal that short-term memory predicts interpretation of syntax for the monolinguals including object relative clauses suggesting that this specific cognitive feature is involved in the more accurate interpretation of this structure.

The differences between the two language groups in terms of which language features were predicted by chronological age may be related to the language groups' overall stage of language development with each of the language features. The monolinguals, by virtue of being exposed to only English throughout their lives, may likely, overall, be at a more advanced stage of English language development.[36] This may mean that factors such as age impact proficiency of language features differently depending on the individual's overall stage of language development. Those at earlier stages of English language development (the bilinguals, who have less English experience overall compared to the monolinguals) may be having to

[36] It should be noted that this could only be verified via a test of the participants' language proficiency.

engage cognitive and linguistic processes more for accuracy in interpretation of a greater number of structures compared to those at later stages of English language development. Future research which measures the impact of factors alongside participants' overall language proficiency would provide further insight on these effects.

In summary, our results suggest that cognitive and linguistic constraints associated with older ages in childhood predict different language features depending on the population under investigation. In relation to sequential bilinguals, these constraints impact comprehension of sentence structures. Whereas, in relation to monolinguals, these constraints impact production on morphosyntax, expressive vocabulary and morphology, and interpretation of passive voice. This suggests a delineation between bilingual and monolingual children in how these constraints impact the processing of language features. How this can be investigated further in future research will be considered later in the chapter (6.5).

6.2.2 Short-term memory

Participants' short-term memory skills were tested with the nonword repetition task from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen & Rashotte, 1999). The task measured the phonological short-term memory component (the ability to temporarily store phonological information from the environment in mind) of working memory through repetition of 18 nonwords (i.e., made up words). In the current, short-term memory predicted mean length of utterance and embedded clauses in narrative production for the bilinguals and interpretation of sentence structures (active and passive voice, and subject and object relative clauses) for the monolinguals. For the sequential bilingual children, the findings reveal that those with higher short-term memory had greater proficiency with expressive morphosyntax (embedded and non-finite clauses and mean length of utterance) in narrative storytelling. This suggests that short-term memory supports the production of morphosyntactic structures in discourse for this population. As mentioned previously in the literature review, bilingual and L2 populations are proposed to have more difficulties with linguistic structures which interface with discourse (Sorace & Serratrice, 2009). In this case, these limitations often manifest for bilinguals or L2 learner populations due to the higher processing demands they encounter at this interface which reduces the processing resources they have available. Consequently, this decreases their efficiency in processing these phenomena compared to monolinguals.[37] Therefore, this finding may suggest that the particular cognitive mechanism of short-term memory facilitates the processing of morphosyntactic features when child L2 children are engaged in discourse, possibly through storage and retrieval of linguistic information. Short-term memory did not predict accuracy of monolinguals' expression of morphosyntax in narrative production. This may reflect differences in processing demands at the syntax-discourse interface for L1 compared to L2 children. As processing demands are conceivably reduced for L1 children in comparison to L2 learners (by way of having knowledge of only one language activated in the brain as opposed to two, and/or due to their possible overall greater experience and stage of development with English), then it is possible that short-term memory will not be as an important factor in this particular linguistic domain for monolinguals.

In relation to short-term memory and monolingual children, this factor predicted interpretation of sentence structures. Again, this may reflect differences in how these structures are processed in L1 versus L2 acquisition. As noted earlier, chronological age predicted interpretation of sentences (active and passive voice, and subject and object relative clauses) for the bilinguals. Therefore, while overall cognitive abilities and language experience associated with older age in childhood impacts the bilingual children's comprehension of sentences, it is specifically one aspect of cognition namely, short-term memory, which facilitates acquisition of structures in L1 acquisition. Another aspect to consider is that plots revealed a much steeper gradient in the slope of effect for the impact of short-term memory on interpretation of object relative clauses compared to the other sentence structures (Figures 5.26-5.29). This indicates that accuracy in interpreting object relative clauses was greater for monolingual participants with higher short-term memory skills compared to the children with lower short-term memory skills. The impact of short-term memory on the monolingual children's interpretation of object relative clauses may suggest that this factor plays a role in the processing of this structure.

[37] It is suggested that difficulties at the syntax-discourse interface often result in cross-linguistic influence from the individual's first language which may manifest through the use of particular structural typology evident in the first language but not the second language. The current study did not measure cross-linguistic influence, so it is unknown if the bilingual children exhibited this effect.

As mentioned previously, object relative clauses comprise a long-distance dependency between the head of the relative clause (the moved argument) and the gap (the place where the moved element originates from and where it receives its thematic role) with an intervening subject noun phrase between the object head noun and the argument's original position (the complement of the verb) (1).

(1) [The cat [CP that$_i$ the dog pushed t$_i$]]…

Object extracted relative clauses are thought to have an increased cognitive cost as language users must retain in memory the dependency between the head noun and the verb while interpreting the intervening subject noun phrase (Wanner & Maratsos, 1978). Our finding could lend support to this hypothesis for L1 acquisition, suggesting that language users may be engaging short-term memory skills to store the moved argument in memory (temporarily storing this phonological information in mind) while processing the subject intervener before the verb is encountered (e.g., Adani, 2011; Chen et al., 2005; Gordon et al., 2001; Just & Carpenter, 1992; King & Just 1991; Lewis & Vasishth 2005; Lewis et al., 2006; Miller & Isard, 1964; O'Grady, 1997; Riches et al., 2010; Traxler et al., 2002; Van Dyke & Lewis, 2003; van Gompel, 2013).

A surprising finding is that while short-term memory predicted comprehension of sentence structures for the monolinguals, it was not a predictive factor of the interpretation of these structures for the sequential bilingual children. This result suggests that the sequential bilingual children may not be engaging their short-term memory capacity for interpretation of sentence structures. It is possible that sequential bilingual children do not process the comprehension of sentence structures in the same way as monolingual children. It may also suggest that at this particular stage in their language development the sequential bilingual children are not engaging their short-term memory skills for the interpretation of sentence structures. It is likely that this may change at a later stage in their language development to reflect the monolinguals' current stage of language development and language processing skills. This could suggest that memory capacity only comes into play for certain language features when children are at a particular point in their language development.

Short-term memory did not predict expressive lexical range for the bilingual participants which contrasts previous studies (e.g., De Cat, 2020; Engel de Abreu et al., 2011; Paradis, 2011; Thorn & Gathercole, 1999; Verhagen & Leseman, 2016). Discrepancies between the studies may be related to differences in how both vocabulary and short-term memory were measured. Most previous research has measured lexical range via a receptive task while the current study used an expressive test of lexical proficiency. In a receptive task, the participant is provided with the name of the item and must choose from four different pictorially represented options. However, an expressive lexical task is much more complex than a receptive task in that the individual must recognise the pictorial form, access the semantic features related to this and retrieve the word before expression. This would suggest that a higher memory capacity may indeed facilitate expressive lexical proficiency more so. However, in terms of the receptive task, it is possible that hearing the item's name alongside four picture reference options may allow the children to more easily retrieve the item using memory skills. In addition, receptive lexical assessments often involve reasoning and excluding options of multiple-choice pictures with cues regarding the meaning of the words (Blom & Bosma, 2016; Cheung et al., 2018). Therefore, it is possible that the reasoning skills involved in receptive tasks may have links to children's other cognitive abilities such as memory. A consideration of how lexical proficiency is measured will be discussed later in the chapter (6.5). In relation to the measurement of short-term memory, most previous studies have used digit span tasks to measure phonological memory rather than the non-word repetition task used in the present study. This may also have contributed to the divergent findings. As Gathercole and Baddeley (1989) propose, while digit span tasks involve the use of number items, non-word repetition reduces the influence of any lexical, semantic and syntactic knowledge. Therefore, the involvement of recalling lexical items in the digit span task, although they are numerical items, may be more closely related to recalling lexical items in general compared to a non-word repetition task.

Determining children's lexical knowledge is an important part of assessing linguistic competency due to its contribution to forming the foundations of language learning (Dickinson & Tabors, 2001; Read, 2000; Tabors, 2006; Treffers-Daller, 2013). However, if we are interested in specifically measuring the impact of memory on children's vocabulary skills then the vocabulary assessment may need to comprise lexical items they have previously encountered. If lexical items are not within the child's current lexical repertoire, then memory skills may play less of a role in their retrieval. A substantial number of the sequential bilingual children in the current study (n=14) knew half or less of the lexical items tested. Therefore, it is not surprising that memory did not significantly predict this measure for the children in the present study. Another important aspect to consider in assessing the lexical knowledge of bilingual children is that their linguistic experiences often cross two different cultural contexts (Chueng et al., 2018). Therefore, the lexical items included in a lexical assessment, which are typically normed for native speaking children in a particular country (e.g., typically, North America or United Kingdom for English language versions of assessments), might not comprise lexical items known to the non-native language learners and therefore the assessment may not be able to capture a full or accurate picture of the bilingual child's lexical range (Chueng et al., 2018). Limitations in relation to the lexical task used will be discussed in more detail later in the chapter (6.5).

It is likely that a wide range of cognitive skills impact children's language processing ability. While the current study measured short-term memory (the part of working memory which allows the temporary storage of information from the environment in mind), other studies have found that a measure of working memory (the involvement of processing or manipulation of information) impacted accuracy of target structures for child L2 learners (e.g., Marinis & Saddy, 2013; Verhagen & Leseman, 2016). Indeed, working memory is thought to be crucial in learning grammar via its participation in noticing and processing language structures (Juffs & Harrington 2011; Mackey et al., 2002). In addition, some studies have found that L2 children with higher analytic reasoning skills as measured via a non-verbal IQ screen (i.e., with higher ability to analyse or detect patterns in language) are more accurate in their use of morphosyntax including third person singular and past tense morphology, and complex narrative clauses (e.g., Paradis, 2011; Paradis et al., 2017). The inclusion of a broader range of cognitive measures will be considered later in the chapter (6.5).

In summary, these findings suggest that short-term memory is important in the production of morphosyntax in narrative discourse for sequential bilingual children, and in interpretation of syntactic structures for monolingual children. This may reflect different ways of processing features between L1 and L2 language development. It may also reflect different overall stages of language development with short-term memory skills being utilised at particular phases in language acquisition.

6.2.3 Age of L2 onset

Age of L2 onset indicated the age at which the participants began meaningful (consistent and significant) exposure to English. The current study found that age of L2 onset had no impact on language measures for the sequential bilingual children. As reported in the results chapter, age of L2 onset had a high-moderate, negative correlation with length of L2 exposure (r=-0.67). Therefore, high collinearity was observed between the two variables. This makes it difficult to tease apart the impact of the variables on the language measures. A Principal Component Analysis was conducted to identify the proportion of variance in the data each of these factors accounted for (determined by calculating the variables' eigenvalues), allowing us to determine the importance of the factors in predicting language measures (Jaadi, 2021). Length of L2 exposure accounted for a substantially higher proportion of the data in comparison to age of L2 onset (81% to 19%, respectively). In light of this, age of L2 onset was removed as a predictor variable.[38]

In contrast to previous research, which has mostly found an older age of L2 onset to predict lexical range in sequential bilingualism in childhood (Blom & Bosma, 2016; Golberg et al., 2007; Snedeker, 2007; Unsworth, 2016a), our study did not find an effect for this factor. The impact of a later age of onset found in previous

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[38] Statistical models with both age of L2 onset and length of L2 exposure were also run to further investigate any impact of the age of onset variable despite the results of the Principle Component Analysis. When both were entered into the same statistical model in R, the programme dropped one of the variables. Therefore, it was not possible to measure the impact of these variables alongside each other in the same model. Furthermore, when statistical models were run with age of L2 onset in place of length of L2 exposure, the only significant result was a higher age of L2 onset effect found for expressive third person singular and past tense morphology (measured via the TEGI task) (p=0.05). This suggests that greater cognitive and linguistic maturity, as per the impact of an older age in childhood, predicts these morphological features. However, obviously, we cannot disentangle the length of exposure effect which was found for these features. These results do however, further confirm that a younger age of L2 onset effect was not found for any language measure.

studies, as with older chronological age, indicate the influence of higher cognitive abilities or the greater linguistic experience (from the L1) associated with older ages. In contrast, in the current study, lexical development was predicted by length of L2 exposure suggesting that, as per other researchers' observations, that lexical development is largely dependent on experience (e.g., Montrul, 2010). Therefore, L2 lexical proficiency for the sequential bilingual participants appears to have a direct link with their L2 exposure time. This will be considered further later in the chapter.

Age of L2 onset is often included in studies on bilingualism due to interests in investigating critical or sensitive period effects in terms of phonology or morphosyntax which are often associated with an early age of L2 onset (e.g., Abrahamsson & Hyltenstam, 2009; Coppieters, 1987; DeKeyser, 2000; Gleitman and Newport, 1995; Johnson and Newport, 1989, 1991; Oyama, 1976; Patkowski, 1980, 1994; Schachter, 1990; Schwartz, 2004a). However, as mentioned before, in the current study, a younger age of L2 onset was not associated with any of the morphosyntactic language measures. The finding for no impact of age of L2 onset in the current study supports previous research (Paradis et al., 2017) which measured this factor's impact on production of multiple clause sentences (measured by way of the ENNI narrative story-telling task). However, as the authors of this previous study point out, the range of ages of L2 onset between participants in their study may have been too narrow to show an impact. The current study included a wide range of ages of L2 onset (7 months to 10;6 years). However, over a third of the participants (15/40) commenced acquisition of the L2 after age 4. Findings from recent studies suggest age of L2 onset effects manifesting for morphosyntax at much younger ages than has been previously stated (e.g., Kroffke & Rothweiler, 2006; Meisel, 2008, 2009, 2016; Rothweiler, 2006; Sopata, 2010). For instance, age of L2 onset effects have been found to manifest as early as age 3;6 (Meisel, 2016). Therefore, it may be the case that due to the number of participants with later ages of L2 onset, our study was unable to capture age of L2 onset effects which may occur at much earlier stages of language development. Furthermore, the current study investigated the impact of predictors in terms of accuracy rates while previous research has detected age of onset effects by examining error types (e.g., Meisel, 2016). It is possible that if this approach was taken in the current study, a different outcome may have been found. In contrast, previous studies may have had different results if proportions of variance in the data between age of L2 onset and any interrelated variables (e.g., length of L2 exposure) were accounted for (e.g., using a Principle Component Analysis). Further consideration in relation to measuring age of L2 onset effects in future research will provided later in the chapter (6.5).

Some previous research (e.g., Rothman et al., 2016) has found an older age of onset advantage for comprehension of passive voice. As per older chronological age, this finding suggests that greater cognitive and linguistic maturity at older ages results in more accurate interpretation of this complex structure. However, in the current study chronological age predicted all sentence structures (both complex and non-complex which included active voice and passive voice). Therefore, the results of the current study do not specifically support this finding. Nevertheless, it should be noted that it was observed that slopes of effect revealed greater differences in accuracy between the younger and older children for the more complex structures including passive voice. This suggested that older chronological age compared to younger chronological age resulted in greater accuracy for passive voice, which would align with this previous finding.

Most previous studies have not found a relationship between age of L2 onset and acquisition of morphology (e.g., Blom & Bosma, 2016; Paradis & Blom, 2016; Snedeker et al., 2007; Unsworth et al., 2014; Unsworth, 2016; c.f. Jia & Fuse, 2007). However, a study by Jia and Fuse (2007) found an earlier age of L2 onset advantage for production of third person singular and past tense morphology. This was only demonstrated longitudinally, taking over two years of L2 exposure to manifest. The L2 length of exposure of participants in the current study ranged widely (7 months to 10;6 years), and 7 participants had a length of L2 exposure under 2 years. Therefore, it may be the case that overall, the current study's participants' L2 input was comparatively not long enough to show this younger age of L2 onset advantage. However, in addition, as the older participants in the Jia and Fuse (2007) study were adolescents at age of L2 onset, it may be the case that this finding would not be replicated in participants who all began acquiring the L2 in childhood such as those in the current study. Another discrepancy is that the task used to record proficiency in the current study was an elicitation task while proficiency of target morphology in the previous study was determined by measuring morphological accuracy in obligatory contexts in spontaneous speech.

Our findings for limited effects of age of L2 onset contrast a large body of research which has found a younger age of L2 onset advantage for morphosyntax in L2 acquisition for both those tested retrospectively in adulthood (e.g., Abrahamsson & Hyltenstam, 2009; Coppieters, 1987; DeKeyser, 2000; Gleitman and Newport, 1995; Johnson and Newport, 1989, 1991; Oyama, 1976; Patkowski, 1980, 1994; Schachter, 1990; Schwartz, 2004a) and for some studies which have tested participants during childhood (Bedore et al., 2016; Nishikawa, 2014; Roesch & Chondrogianni, 2016). While many of these early studies have supported a 'younger is better' perspective and critical period effects for language acquisition, the findings from our study are not consistent with either of these. Age of L2 onset is often confounded with input effects. As mentioned previously, in the present study, age of L2 onset was highly and negatively correlated with length of L2 exposure. However, on carrying out the Principal Component Analysis, it was revealed that length of L2 exposure accounted for a substantially higher variance in the data. This may indicate that in previous studies where an age of onset effect has been found, but length of exposure has not been accounted for, then this input variable may in fact be driving these results.

These results for age of L2 onset have implications for applied perspectives such as teaching and supporting newcomer children in educational settings. For instance, the 'earlier is better' view for acquisition of a second language is pervasive (e.g., Abrahamsson & Hyltenstam, 2009; DeKeyser, 2000; Johnson and Newport, 1989, 1991). However, previous and more current research has demonstrated that older sequential bilingual children, at least in the initial stages of acquisition, have an advantage in acquiring language (e.g., Armon-Lotem et al., 2011; Blom & Paradis, 2015; Blom & Bosma, 2016; Bohman et al., 2010; Golberg et al., 2008; Paradis, 2011; Paradis et al., 2017; Rothman et al., 2016; Snedeker et al., 2007; Snow & Hoefnagel-Hohle, 1978). This is often referred to as the rate advantage. While it has been proposed that those who begin earlier catch up and may surpass those who started acquiring the language at a later age (e.g., Jia & Fuse, 2007), this could be confounded with length of exposure effects. In the current study, the sequential bilingual participants had a mean length of L2 exposure of 4;2 years. Therefore, this suggests that the older age advantage found for complex morphosyntax may hold for a considerable number of years and possibly within the children's time at primary school. This could have implications on how sequential bilingual children can be best supported in educational settings. In this case, educators could harness the advantages associated with older ages by ensuring older sequential bilingual children have a wealth of opportunities for engagement with more complex language features so that these can be practised to become established language features within their L2 language repertoire. This could have positive effects in terms of academic skills (e.g., in writing where more complex language features are often utilised) which may ultimately have far-reaching consequences regarding future educational prospects (McEachron, 1998; Paradis, 2005).

In summary, our study did not show an effect for age of L2 onset, and perhaps more importantly, results do not provide support for a younger age of L2 onset advantage or critical or sensitive period effects.

6.2.4 Motivation

Motivation in the current study was measured by the participant's main school teacher rating the child's motivation for learning English on a scale of 1 to 5 (1=low ability and 5 = high ability). The vast majority of participants in the current study were scored 100% for motivation. Therefore, there was not enough variation across children's scores for an impact to be detected and consequently this variable was removed from the statistical analysis. As presented in the literature review, motivation has been shown to be a robust predictor of language proficiency in adult L2 acquisition (e.g., Dörnyei, 1994; Dörnyei, 1998; Shirbagi, 2010; Ushioda & Dornyei, 2012). As the children scored very highly for this measure it may suggest that motivation is more important in acquisition of an L2 in adulthood and in a classroom setting rather than in an immersive language situation in childhood. It may also be the case that asking teachers to rate the children's motivation did not provide an adequate measure for this factor. Previous studies have used semi-structured interviews where participants (or their parents) were asked questions related to their motivation for learning the L2, such as their language preference, their attitude towards the L2, the positive or negative factors which affected their L2 learning, how happy they were in relation to their level of proficiency, and reasons for learning the L2 (Jia & Aaronson, 2003; Shoaib & Dornyei, 2005). The inclusion of more fine-grained measures for motivation may have resulted in more variation among the participants and therefore its impact could have been measured within the statistical analysis.

6.3 External measures

6.3.1 Length of L2 exposure

Length of L2 exposure measured the participants' overall meaningful (consistent and significant) exposure to English. Results from the statistical analysis showed that length of L2 exposure predicted the expressive lexical and morphological (third person singular and past tense measured via the TEGI task) proficiency of the sequential bilingual participants. The impact of the bilinguals' overall L2 exposure on lexical proficiency supports the view that this domain is context specific depending largely on experience (Montrul, 2010). The finding also supports previous research which has found an effect for this variable on lexical proficiency (e.g., De Cat, 2020; Sorenson Duncan & Paradis, 2018; Unsworth, 2016). The impact of length of L2 exposure on proficiency of expressive third person singular and past tense morphemes, suggest that, as with lexical proficiency, the development of these language features may also depend on the amount of the learner's L2 exposure. This result supports previous results finding a length of L2 exposure effect for morphological proficiency (e.g., Chondrogianni & Marinis, 2011; Unsworth et al., 2014; Unsworth, 2016). In contrast, length of L2 exposure did not predict interpretation of target sentence structures (active and passive voice and subject and object relative clauses) or use of morphosyntax in narrative storytelling. Instead, internal factors and more fine-grained measures of input where important for these language measures. This suggests that development of grammatical sentence structures and features have a biological component related to maturation and cognition. However, in some cases (interpretative syntax), they are also driven by environmental factors, but those which specifically contribute to richer input. These more fine-grained input measures will be discussed further in the following sections.

6.3.2 Richness of the L2 environment

Richness of the L2 environment was measured by way of the following: how often the child engages in social/extracurricular activities with the L2 as the language of instruction (0 = Almost never/Never, 1 = At least once a week, 2 = Everyday); and the language spoken between the child and the friends they regularly play with, using a 5-point rating scale (1 = Mother tongue always/English never, 2 = Mother tongue usually/English seldom, 3 = Mother tongue 50%/English 50%, 4 = Mother tongue seldom/English usually, 5 = Mother tongue almost never/English almost always). Results revealed that richer L2 environmental experiences which involve an increased participation in L2 play and social activities predicted both complex and non-complex syntax for the sequential bilingual participants. This included interpretation of active and passive voice and subject and object relative clauses. This outcome suggests that naturalistic exposure to the L2 in activity- or play-based situations facilitates sequential bilingual's language competency of both simple and complex sentences (e.g., Folli et al., 2015; Kane et al., 2017). Conceivably, these experiences are providing the sequential bilingual children with valuable opportunities to hear and use the L2. These findings support previous research which associates peer play and social interaction with language development in both first language acquisition (e.g., Collier, 1979; Lovinger, 1974; Smilansky, 1968; Smith & Syddall, 1978; Yawkey & Fox, 1981) and bilingual and child L2 acquisition (e.g., Ervin-Tripp, 1991; Fassler, 1998; Piker, 2013). It is likely that the play and social settings the sequential bilingual children are participating in offers engagement with native English speakers who may be providing skilful language modelling of the target structures predicted by this measure. This supports research which indicates that interaction with peers on its own is not enough for language development. Rather, children require exposure to considerable amounts of 'expert' speakers (native or highly proficient speakers) for peer interaction to have an impact on language acquisition (Hoff, 2006).

A peculiar finding is that while richness of the L2 environment predicted interpretation of relative clauses it did not predict production of embedded clauses in the narrative task. This finding suggests that L2 play and social activities have more of an impact on interpretive as opposed to expressive syntax. It may be the case that as comprehension of language is typically acquired before production, these experiences have more of an impact on the children's comprehension abilities. On the other hand, it seems somewhat counter-intuitive considering that increased participation (and conceivably interaction) in L2 play and social activities implies greater expressive use of sentences. Furthermore, previous research (Paradis et al., 2017) using the same narrative task (ENNI) found this factor to predict expressive syntax ($p=.046$). As mentioned before, the previous and current study included somewhat different types of structures as cases of complex narrative sentences which may have resulted in the divergent findings. Whereas the previous research measured use of complement, coordinate, adverbial and relative clauses and ambiguous sentences, the current study involved measuring use of subordinate and non-finite clauses. Furthermore, variation in results between studies may have emerged due to differences in measures of L2 richness. In the current study this measure included how often the child engaged in social or extracurricular activities with the L2 as the language of instruction and how often the child engaged in L2 play with friends. The measure of richness of the L2 environment in the previous study also included children's engagement with the L2 through media such as computer games, television and books. The lack of impact of richer L2 interaction on expressive syntax is nevertheless a surprising finding. This may be related to the narrative task used as the monolingual children had surprising low scores for this task. This will be explored further later in the chapter (6.5).

6.3.2.1 Richness of the L2 environment - Interdependencies

The influence of L2 richness on interpretation of some of the target syntax demonstrated a more complex picture in that it was found to interact with chronological age in predicting proficiency. Interactions between these factors were found for the two more complex structures: passive voice and object relative clauses. The earlier results showed that being older resulted in higher accuracy of the sequential bilingual's interpretation of complex structures. However, this interaction between age and a richer L2 environment demonstrates that accuracy was much greater for the older children when they had richer L2 experiences. Children whose score for participation in L2 play and social activities was around the mean (L2 richness score = .76) or one standard deviation above the mean (L2 richness score = .93) showed a considerable increase in accuracy of passive voice and object relative clauses with age. This result suggests that older primary school-aged children are supported in processing these structures via richer L2 input received through greater participation in L2 play and social activities. This may indicate that conceivably higher levels of cognitive capacity and greater overall language experience (from the L1) at older ages are important for interpretating complex syntactic structures in this population. Therefore, richer L2 experiences alongside greater language experience and cognitive skills, may be granting sequential bilingual children higher proficiency when interpreting sentence structures with more complex features. This includes reinterpretation of semantic roles and grammatical categories (passive voice) and structures with intervening constituents (object relative clauses). This may indicate that the impact of greater participation in L2 play and social activities is much more impactful when bilingual children have conceivably more well developed cognitive and linguistic functioning skills for the more adequate processing of these structures. Therefore, richness of the L2 environment will not be as influential on accuracy for younger bilingual children with conceivably less well developed cognitive and linguistic functioning ability in adequately processing these more complex structures. These findings have implications in relation to how parents of L2 children could be advised to support L2 development. In this case, educators could advise parents of sequential bilingual children to encourage their participation in play or social activities with the L2 as the primary language. This may facilitate the child's L2 language skills in terms of complex language features, especially when children are older.

In summary, these findings in relation to richness of the L2 environment suggest that input which specifically involves increased interactions in the L2 via play and social activities with peers, and which most likely involves exposure to native speakers, has a significant impact on the interpretation of both complex and non-complex syntax. In the current study, the inclusion of length of L2 exposure allowed us to account for quantitative input which was not found to be a predicting factor for the target syntactic structures. Furthermore, a correlation analysis revealed that L2 richness and length of L2 exposure had little if any correlation ($r=.29$) (Calkins, 2005) indicating that these qualitative and quantitative factors had no, or almost no, relationship. This suggests that qualitative as opposed to quantitative input is important for interpretation of syntactic language measures. Only a few previous studies (e.g., Paradis, 2011; Paradis et al., 2017) have included richness of the L2 environment as a separate predictor of language proficiency. Qualitative factors such as participation in extracurricular activities have most often been incorporated within a combined measure of L2 language exposure alongside quantitative input measures (e.g., De Cat, 2020; Chondrogianni & Marinis, 2011; Jia and Fuse, 2007; Unsworth, 2013). Thus, measuring types of input separately allows a more fine-grained insight on the impact of specific types of input in various situations.

6.3.3 Socioeconomic status

Socioeconomic status was a combined measure of the participants' mothers' education level and English L2 proficiency. Maternal education was measured by asking the mothers of participants to rate their educational level using a 6-point scale (1 = Primary education, 2 = Secondary education, 3 = Higher Educational Institution, 4 = Undergraduate degree, 5 = Masters, 6 = PhD). Maternal L2 proficiency was measured by asking the mothers to rate their fluency in English using a 5-point rating scale (1 = No understanding/ speaking ability, 2 = Some understanding and can say short, simple sentences, 3 = Good understanding and can express myself on many topics, 4 = Can understand and use English adequately for work and most other situations, 5 = Can understand almost everything/very comfortable expressing myself in English in all situations).

Our study found that higher socioeconomic status did not predict greater ability for any language measure. In fact, our results revealed a negative beta coefficient for the impact of socioeconomic status on mean length of utterance and embedded clauses in narrative production, indicating that increases in socioeconomic status resulted in significant decreases in scores for these language measures. Therefore, children from lower socioeconomic status backgrounds (i.e., whose mothers had lower educational levels and English L2 proficiency) had higher mean length of utterance and use of embedded clauses in narrative discourse.

The finding that socio-economic status does not impact lexical proficiency is surprising in terms of the positive impact found for this factor in previous research on lexical proficiency in child L1 (e.g., Hoff, 2003; Hoff et al., 2002; Huttenlocher et al., 2002; Vasilyeva et al., 2008) and child L2 (e.g., Chondrogianni & Marinis, 2011; De Cat, 2020; Hammer et al., 2012; Oller & Eilers, 2002) acquisition. The lack of impact found for this factor in the present study may be due to the disproportionate numbers of mothers in the present study with higher level qualifications. Maternal education was calculated in terms of the highest qualification obtained and the majority of participants' mothers in the current study had advanced level qualifications which included an undergraduate degree, master's degree or PhD level education (n=24). In contrast, fewer (n=6) had lower level qualifications (including primary or secondary school level education) as their highest qualification. Therefore, it may be the case that there was not enough variation across participants to find an effect for this factor across language measures.

An important point to note is that although maternal education is used as part of the measure for socio-economic status in the current study, the education of mothers may not have accurately reflected their current economic and social position. As many of the mothers had conceivably come to Northern Ireland as refugees, it may be the case that on arrival to Northern Ireland, and indeed for some time afterward, many may not have been able to secure employment comparable to their level of education or that which they had in their country of origin. Therefore, maternal education in the case of refugee families may not in fact equate to socio-economic status. Discrepancies between level of education and actual socio-economic status of refugees was also highlighted by Passel & Cohn (2009) in relation to the US context. This study revealed that although 28% of legal refugees and 15% of illegal refugees were college educated, they lived on or below the poverty line. In addition, it seems comprehensible that the other parent or caregiver (if present) would also play a role in the family's economic and social status and therefore, the inclusion of their educational level and occupation is also relevant.

Previous research (Sorenson Duncan 2017; Sorenson Duncan & Paradis, 2018) has also shown that the impact of maternal education may represent a more complex picture in which its impact depends on whether the mother received her education in the L1 or L2. These previous studies found that maternal education completed in the L2 impacted positively on the children's L2 language proficiency. Although the current study did not measure the language of the mothers' education, it was noted that a number of families were present in Northern Ireland because the mother was enrolled on a masters or PhD degree programme at a local university and were therefore completing their education in the L2.

In summary, our study found no impact for higher socio-economic status on any language measure. However, there may not have been sufficient variation among participants to find an effect for this factor. In addition, in the case of sequential bilingual children, the use of maternal education as a measure (or part of a measure) for socio-economic status may require a more nuanced approach. This method could take account of other factors which may influence the family's socio-economic status such as the parent/caregiver(s) current occupation, and the language in which they completed their education.

6.3.4 L2 language use at home

L2 language use at home was measured via the following: English use by each household member (including all adults and siblings present at home, if applicable) to the child, and from the child to each household member, by choosing a score from a 5-point rating scale (1 = Mother tongue always/English never, 2 = Mother tongue usually/English seldom, 3 = Mother tongue 50%/English 50%, 4 = Mother tongue seldom/English usually, 5 = Mother tongue almost never/English almost always). The overall score for L2 language use at home was calculated as per the ALEQ parent questionnaire (Paradis, n.d.; Paradis, 2011). This was completed by totalling each score for the relevant questions/rating scales and dividing by the number of scores to get a proportional score (See Appendix D for further information and an example).

As reported in the results chapter, L2 language use at home had a moderate correlation with length of L2 exposure (r=.59). Therefore, it was not possible to include both variables in the same statistical model as it would not have been possible to tease the impact of the variables apart. A Principal Component Analysis was conducted to identify the proportion of variance in the data each of these factors accounted for (determined by calculating the variables' eigenvalues), allowing us to determine the importance of the factors (Jaadi, 2021). Length of L2 exposure accounted for a substantially higher proportion of the data in comparison to L2 language use at home (80% to 20%, respectively). In light of this, L2 language use at home was removed as a predictor variable.[39] The lack of impact of the child's L2 use in the home setting suggests a negligible impact for this factor on sequential bilingual's L2 proficiency. The measurement of this factor included the amount of L2 they spoke to siblings, parents and other adults at home and the amount of L2 others used with the child in the home setting. This finding reflects previous studies which have included this particular factor as a separate measure (e.g., Paradis, 2011; Paradis et al., 2017). As reported in these previous studies, the lack of impact for L2 use in the home may be related to the diminished quality in the L2 in this setting. As language users (siblings and parents/caregivers) are typically non-native speakers or have reduced L2 proficiency, this may not sufficiently contribute a positive impact on the child's L2 language ability (Hoff et al., 2014; Place & Hoff, 2011), or at least the target measures included in the present study.

Where research has included more fine-grained measures of language input, which often have included a cumulative (over time) measure of second language exposure and use at home, results are mixed with some studies showing weak or no effects (e.g., Armon-Lotem et al., 2011; Chondrogianni & Marinis, 2011; Unsworth, 2016a). In contrast, others (e.g., De Cat, 2020; Roesch & Chondrogianni, 2016) find this type of exposure (cumulative input) to be the most important factor for proficiency of target sentence structures. However, in these cases, qualitative input was included as part of the overall input measure. Therefore, it may be the case that a specific type of input was driving these results either way. As discussed earlier in the chapter, other fine-grained measures of input, namely richness of the L2 environment (experiencing richer L2 possibly through interactions with native speaking peers) has been shown to predict interpretation of complex sentence structures for this population. Therefore, in relation to fine-grained measures of input, and supporting what has been found in similar previous studies (e.g., Paradis, 2011; Paradis et al., 2017), it is quality of L2 experiences as opposed to quantity that seems to be a key element for better L2 proficiency.

[39] Statistical models were also run with L2 language use at home included to determine if this factor did have any impact, in spite of the results of the Principal Component Analysis. It was not found to be a significant factor in any model. Therefore, the current study found that L2 language use at home did not predict any language measure in the current study.

6.3.5 L2 language use at school

L2 English use at school was evaluated by the child's main primary school teacher rating their percentage use of English in the school environment. As with motivation for learning the L2, the vast majority of participants in the current study were scored 100% for L2 language use at school by their teacher. Therefore, there was not enough variation across children's scores for an impact to be detected and consequently this variable was removed from the statistical analysis. The measure used in the current study may have been too broad and was therefore unable to capture more fine-grained results for this factor. Where this factor is included in previous studies it is typically measured as part of a combined input score (e.g., De Cat, 2020; Unsworth, 2016). Future directions for this measure will be discussed later in the chapter (6.5).

6.4 Summary of discussion

In summary, the maturation of cognitive and linguistic abilities and overall language experience associated with older age in childhood predict different language measures depending on the language population. Age predicted interpretation of syntactic structures (actives and passives and subject and object relative clauses) for the bilinguals. In contrast, for monolinguals, the same factor predicted mostly expressive language features (vocabulary, morphology and narrative morphosyntax) and interpretation of sentences involving mapping non-canonical semantic roles to their respective grammatical categories (passive voice). It may be the case that cognitive abilities or language experience associated with age are important for the interpretation of syntax at an overall earlier stage of language development (bilinguals). In contrast, at an overall later stage of development (monolinguals), these same characteristics only remain important for processing complex structures such as passive voice and in expressive storytelling.

The impact of short-term memory on language features also depended on the language group under consideration. Short-term memory appears to play a role in processing expressive morphosyntax in discourse for the bilinguals. In contrast, for the monolinguals, short-term memory appears to facilitate comprehension of syntactic features. These differences between language acquisition populations in relation to short-term memory may represent differences in how particular language features are processed by different linguistic groups. The impact of short-term memory on expressive morphosyntax for the bilinguals may be linked to the greater processing demands bilinguals experience with language phenomena when it interfaces with discourse. The impact of short-term memory on interpretation of syntax for the monolinguals suggests that these language users may be engaging short-term memory skills to facilitate the storage of particular syntactic elements of the sentence structure in memory for their adequate processing.

Participation in richer language experience through play and social activities was found to predict interpretation of both simple and complex syntactic structures for the sequential bilingual children. These interactions, which likely involve native-speaking peers and learning through play-based set-ups, are important for the language development of children acquiring a second language. Indeed, these experiences can boost proficiency of some complex language features when children's cognitive and linguistic skills are higher (older children). Therefore, educators or advocates of sequential bilinguals could encourage parents to have their children participate in these types of activities to facilitate their L2 proficiency. In contrast, L2 language input via non-native speakers in the home environment appears to have a negligible impact on language proficiency. Therefore, not all L2 encounters have a significantly, positive impact on L2 language development. In terms of interpretation of syntax, it is quality of L2 experiences as opposed to quantity, that seems to be a key element in relation to input and greater L2 proficiency.

A younger age of L2 onset was not shown to be an important factor in the current study. This contrasts the notion of sensitive or critical period effects in language acquisition and therefore, the 'younger is better' perspective in language acquisition. However, future research incorporating a wider age of onset range which includes more participants with much younger ages of onset may provide further understanding of the particular stages that age of onset effects manifest.

L2 language use at school and motivation for learning the L2 were shown to be lacking in relation to their variation between participants. Therefore, more fine-grained measures through parent or participant questionnaires may be needed in these cases to measure impact more appropriately.

Higher socio-economic status did not predict greater proficiency of any language measure. However, in the case of sequential bilingual children, the measure of socio-economic status may require a more nuanced approach which also involves the parent/caregiver(s)' current occupation and the language in which they completed their education.

The following section will examine the study's limitations and consider directions for future research.

6.5 Limitations and future research

This study has extended the discussion of sequential bilingualism in childhood by exploring how a wide range of individual difference factors and their interdependencies predict proficiency of several language features which are complex and non-complex. A number of future directions could be taken to further expand on the findings of this study. These include areas related to the study's participants and the tasks and materials used for measuring language proficiency and factors. These will be explored further in the following sections.

6.5.1 Participants

A number of the bilingual participants may have been refugees which may have impacted their attendance at school both in and outside of their home country with consequences in terms of literacy skills. In addition, many refugees may face key risk factors prior to resettlement, which can include exposure to violence, separation from family, and poverty. Challenges can endure long after resettlement as individuals may experience post-traumatic stress disorder, discrimination, and culture shock (Soto-Corominas et al., 2020). Consequently, this population can experience many challenges to their wellbeing including their confidence, self-esteem and interpersonal and social skills (Hadfield, 2017). Furthermore, recent research has found there to be an interaction between the wellbeing of refugees and proficiency of the second language. Specifically, research shows that those with greater wellbeing as measured by way of higher self-control and interpersonal skills and lower incidences of problem behaviours, have much greater proficiency in the second language (e.g., Han, 2010; McNally et al., 2019; Soto-Corominas et al., 2020; Zins et al., 2004). Unfortunately, the current study did not ask the mothers to indicate whether the children were refugees, how much school they had missed, and did not include a measure of wellbeing. Including these factors in future research would provide further insight on their impact of this population's L2 proficiency.

In the current study, the L1 was controlled in that the main language used at home for all the sequential bilingual participants was Arabic. However, the participants, or their parents, originated from thirteen different Arabic-speaking countries (Appendix A). Due to the different countries of origin, it was likely that the bilingual participants had exposure to Arabic with dialectal variations. These differences in their L1 Arabic may have had an influence on how their L2 English was acquired. Further analysis of the data set in which the dialectal version of Arabic spoken is measured as a predictor variable, or the inclusion of a higher number of participants with particular L1 dialects, would provide greater insight on the impact of different types of L1 Arabic on language measures.

A number of the participants in the study (n=8) were trilingual as opposed to bilingual speakers: 2 children spoke French and Arabic, 3 spoke both Kurdish and Arabic, and 2 spoke Somalian and Arabic. It may be the case that the presence of another language had an influence on their L2 English proficiency. However, the scores for language measures of the trilingual children were overall, not shown to deviate from the participants' mean scores (Appendix I). Nevertheless, a number of studies have found advantages for acquisition of a third language (L3) in comparison to those acquiring the same target language as an L2 (e.g., Bild & Swain, 1989; Cenoz & Valencia, 1994; Sanz, 2000). Therefore, English acquired as an L3 as opposed to an L2 could have an impact for trilingual children. Future analysis including more participants acquiring the target language as an L3 would provide a greater understanding of whether having already acquired an L2 impacts the acquisition of the target language differently compared to those who were monolinguals before commencing acquisition of the target language.

Another future direction for the current study is considering the impact of the participants' L1 on their L2 English proficiency. This was not statistically measured in the current study. To appropriately measure any cross-linguistic influence, the results from at least two groups of participants with different L1s would need to be included and statistically compared. Cross-linguistic influence is important to consider as it has been shown that the native language can impact the acquisition of L2 grammatical structures as seen through the use of target and non-target like structures produced by child L2 learners (e.g., Blom et al., 2012; McDonald, 2000; Zdordenko, 2010). Indeed, some theories of L2 acquisition view the L1 as a main source of influence in acquiring the L2 (e.g., The Fundamental Difference Hypothesis, Bley-Vroman, 1990; Full Transfer/Full Access Model, Schwartz & Sprouse, 1994). Moreover, shared structural typological features between the L1 and L2 may create convergent target language constructs which can facilitate L2 progress while different typological features may result in divergent patterns (Alexopoulou, 2020; Blom et al., 2012; Haznedar, 1997; Gilkerson, 2007; McDonald, 2000; Murakami & Alexopoulou, 2016; Zdordenko, 2010). As shown in the literature review, typologically, Arabic diverges greatly from English in relation to passive voice. For instance, Arabic does not permit the agent to appear on the surface structure of passive sentences therefore forming or recognising the by-phrase of passive voice in English may be problematic for Arabic speakers (Khalil, 1993). Therefore, a future direction could be to compare the Arabic speaking children's interpretation of passive voice with those of children whose first language requires an obligatory by-phrase and agent form. A language which requires these features is Cantonese. Cantonese forms passives with the preposition béi introducing the agent of the action before the verb. In spoken Cantonese, the passive construction must contain a noun phrase after the béi preposition representing the agent of the action (2) (Matthews & Yip, 2011).

(2)	mauu	béi	gau	zeoil
	cat	by	dog	chase
	'the cat is chased by the dog'			

(Leonard et al., 2006)

If cross-linguistic influence from the L1 is present, the Cantonese speaking children are expected to interpret the full English passive structure (with a by-phrase and agent) significantly more accurately than the Arabic speaking children.

As presented in the literature review, relative clauses in Arabic have a similar structure to English which includes the use of a complementizer (e.g., allaði or lli). However, where they diverge is that while in English there is no resumptive pronoun in the position of the gap left by movement in either subject or object relative clauses, in Arabic, object relative clauses use the resumptive clitic pronoun ha to indicate the location of the relativized head of the relative clause (Albrini & Benmamoun, 2014; Aoun et al., 2010). Therefore, it may be the case that participants use the overt resumptive pronoun (or lack of this pronoun) as a cue to indicate whether the sentence is a subject or object relative clause. However, the absence of an equivalent cue in English may hinder accurate interpretation.

These typological similarities and differences between the participants' L1 and the equivalent structures in English may have influenced their proficiency of the target structures and resulted in passives and object relative clauses being more difficult to comprehend in comparison to subject relative clauses. Investigating the impact of the participants' first language was beyond the scope of the current study. Future research incorporating more than one L1 background (e.g., Cantonese in relation to passive voice, as presented above) would provide greater insight on the influence of cross-linguistic influence for this population. Additionally, it may be the case that the child's age and therefore, their less or more advanced knowledge of the L1 may also impact how specific structures are acquired in the L2. One way to investigate this further could involve assessing the children's proficiency in the equivalent Arabic L1 target features. This may allow us to see whether a higher or lower proficiency of the structure in the L1 impacts knowledge of the same structure in the L2.

6.5.2 Language measures

The current study included a variety of different tasks to investigate language proficiency across domains. Some tasks were expressive (lexical, morphological and narrative) and others were receptive (active, passive and relative clause sentences). Therefore, it is unknown if any discrepancies were present in relation to comprehension versus production for many of the language features included in the study. Future research including interpretative lexical and morphological tasks and elicitation tasks to probe expressive use of all target sentences would provide further insight on this population's language acquisition across domains.

The lexical task used in the study (The Renfrew Word Finding Task) assessed only concrete nouns and no other word categories (e.g., verbs, adjectives, adverbs). Results found in relation to the impact of predictors on the children's lexical ability is therefore restricted to these noun types. Furthermore, this assessment may have drawbacks in relation to the pictorial representations of target items. For instance, some of the drawings include more than one item displayed on the card which have made deciphering and naming the target items more difficult. In addition, it may be that some items refer to objects which could be viewed as somewhat outdated and therefore not as well known to the participants (e.g., one target item is a TV aerial and while these are still generally used, this is not always the case due to the common use of cable, satellite and the internet as ways to watch television programmes). Another difficulty is that the task may be linguistically and culturally biased. As mentioned previously, lexical items included in a lexical assessment are typically normed for native speaking children in a particular country. Therefore, they may not comprise lexical items known to the non-native language learner and therefore the assessment would not capture a full picture of the bilingual child's lexical range (Chueng et al., 2018).

The assessment used for testing morphological proficiency (the TEGI screening tool) assesses two morphological features only (third person singular and regular and irregular past tense) and therefore cannot give a comprehensive evaluation of morphological proficiency (e.g., which would include other morphemes such as present progressive, copula and auxiliary forms, and do support). Previous studies have determined morphological proficiency across a wide number of morphemes by measuring their accuracy in obligatory contexts in spontaneous speech (e.g., Jia & Fuse, 2007; Logue, 2016). This allows more naturalistic speech to be captured which may convey a truer representation of the individual's morphological knowledge (Granger, 2011).

The picture elicitation story task (The Edmonton Narrative Norms Instrument, ENNI, Schneider, Dubé & Hayward, 2005) was used to evaluate the participants' production of morphosyntax. However, narrative tasks involve the production of spontaneous speech which can result in a lack of comparability between participants (Bardovi-Harlig, 2013). Many of the speech samples from this task were very limited in the number of sentences produced. This was observed even for a number of the monolingual participants who had very high scores across all target morphosyntax. This may indicate that this measure was not sufficiently sensitive in capturing linguistic performance of target language features for monolingual and bilingual populations. It may have been the case that some children who were more comfortable with storytelling or who were more naturally extroverted may have been able to give fuller descriptions of the story pictures therefore affording them higher scores for this activity. Paradis et al (2017) also noted limited speech production specifically in in relation to complex sentences. Using the same narrative task, they found that children produced more complex sentences in spontaneous speech during play than they did in the narrative task which they associate with using a story generation task as opposed to a story retell task (p.162). Future research incorporating a story retell task may result in the children producing more language and provide greater opportunities for their use of more diverse language features including complex structures.

6.5.3 Factors

The current study used a parent questionnaire to gather information on the sequential bilingual children’s language backgrounds as has been commonly done in other bilingual language acquisition studies (e.g., De Cat, 2020; Paradis, 2011; Paradis et al., 2017; Sorenson Duncan, 2017; Unsworth, 2013; Unsworth et al., 2014). However, the use of questionnaires may have resulted in some inaccuracies regarding environmental effects. For instance, responses may be unreliable especially if parents are reporting on situations which occurred some years in the past, or in some cases their responses may reflect social expectations as opposed to the real-life circumstances (Unsworth & Blom, 2010). The current study used a parent questionnaire translated to Arabic and given to the participant’s mother to complete in their own time. However, parent questionnaires are often administered through a spoken interview between the parent and the researcher and typically with the aid of an interpreter (e.g., Paradis, 2011; Sorenson Duncan, 2017; Unsworth, 2013; Unsworth et al., 2014). The use of an interpreter was not feasible for the present study however, it may have ensured any difficulties or discrepancies with providing information could be resolved and therefore, more accurate information supplied.

Richness of the L2 environment was found to be one of the most important factors in the present study and indicated that increased participation in L2 play and social activities facilitates acquisition of both complex and non-complex sentence structures. This factor was measured by asking the participants' mothers to rate the following: (1) the child's participation in L2 play, on a scale between 0-2; and (2) the child's participation in extracurricular activities with the L2 as the language of instruction, on a scale between 1-5. A proportional score of these two variables was calculated as per the ALEQ and shown in Appendix (D). As with all of the measures in the parent questionnaire, the mothers self-reported on the circumstances of the child's language background and input. Therefore, the measure of their child's participation in L2 play and social activities is subjective and may not fully reflect the actual situation in relation to these measures. It may be the case that teachers or teaching assistants at school could provide a more accurate account for this factor, at least for where these activities occur in the school environment. In addition, further research exploring the specific types of activities and play the children are involved in, the types of language users they engage with, and the kinds of language used among the children during these play and social activity settings, would enrich the results on the quality of input and its influence on language proficiency.

The input measures included in the present study provided information on the sequential bilingual children's current input only. However, the bilingual children's circumstances may have changed considerably over the course of their life which may have had an impact on the amount of L2 English they have been exposed to. Recent research has included a cumulative input measure (e.g., De Cat, 2020; Unsworth, 2013, 2016a) which measures language exposure from the child's birth to time of testing which may provide a more accurate measure of L2 input.

In the current study, no environmental measures were included for the monolingual participants. As mentioned in the results chapter, some environment and L2 related factors (e.g., age of first meaningful exposure to the L2, L2 language use at home, and L2 richness of the environment) do not directly apply to the monolingual-speaking individuals. As monolinguals speak a single language and therefore conceivably represent a homogenous group this may make it more difficult to measure variation in environmental related language exposure. However, recent research has challenged the homogenous view of monolingual input (e.g., De Houwer et al., 2014) therefore, it could be the case that variation in L1 English input (e.g., at home, activities, play, school, etc.) would influence their English language use. In addition, there would likely be variation among this group in relation to socio-economic status. Future research incorporating these measures for monolingual participants would shed more light on the impact of input across language populations.

In relation to L2 language use at school, future research could include a more detailed account of L2 input in school environment to capture more fine-grained results for this factor. This could include asking teachers to evaluate the children's L2 use at school by using rating scales similar to what was used in the current study for L2 language use at home and richness of the L2 environment. This could involve rating the children's engagement in school activities and sports with the L2 as the language of instruction, how often their play with others involves the L2 as the primary language, how often they interact/play with native-English speakers at school, and how often they engage in L2 literacy activities.

Future directions using the current data set could include investigating whether the bilingual child's birth order or the presence of older school-aged siblings have an impact on their language proficiency. Previous research on birth order in L1 acquisition has shown mixed results. Some studies show that first born children have greater language proficiency than second born children (e.g., Bornstein, Leach, & Haynes, 2004; Hoff, 2003; Zambrana et al., 2012; Zyrianova et al., 2013). In contrast, others have found that children with older siblings have more advanced language proficiency (e.g., Barton & Tomasello, 1991; Oshima-Takane, Goodz, & Derevensky, 1996) which is associated with differences in language input. For instance, language exposure for the younger sibling may increase simply as a result of there being an additional interlocutor in the household (the older sibling) (Tsinivits & Unsworth, 2021). In terms of bilingual children, some research (e.g., Bridges & Hoff, 2014) has shown that children with older, school-aged siblings had greater exposure to the majority language (English) at home than children without older siblings. An older sibling, who may have a preference for the L2 due to it being the dominant language in interaction with peers at school, may bring the L2 into the home. This preference may then be extended to interactions with their younger siblings allowing greater L2 exposure which supports its development (Bridges & Hoff, 2014). More exposure to the L2 at home from older siblings has been found to be associated with more proficient vocabulary and inflectional morphology (e.g., Sorenson Duncan & Paradis, 2020; Tsinivits & Unsworth, 2021) and narrative macro-structures (Sorenson Duncan & Paradis, 2020) for sequential bilingual children. Therefore, a future direction in relation to the current study, would be to analyse the bilingual children's birth order and presence of older, school-aged siblings to investigate whether these factors impact their proficiency or use of language measures.

The study found that age of L2 onset was not an important factor for the sequential bilingual children's language proficiency. However, the impact of age of onset may be exhibited at earlier stages of language development (e.g., Kroffke & Rothweiler, 2006; Meisel, 2008, 2009, 2016; Rothweiler, 2006; Sopata, 2010) or take several years to manifest (e.g., Jia & Fuse, 2007). Due to the more limited number of participants with lower ages of onset (as well as the cross-sectional as opposed to longitudinal nature of this research) the current study may not have been able to capture age of onset effects. Furthermore, while the current study investigated the impact of age of L2 onset in terms of accuracy rates, previous research has detected age of onset effects by examining error types (e.g., Meisel, 2016). Therefore, a future direction for research would be to include a larger number of children commencing L2 acquisition at younger ages and to investigate their accuracy and error types longitudinally to provide further insight on these effects.

While the findings of this thesis have suggested that older chronological age is associated with greater proficiency of language structures, it does not tell us whether there are specific optimum ages in relation to the processing of these features or at which ages changes in terms of the proficiency of processing these features occur. A future direction would be to analyse the data further to include examining individual participants' scores and ages to determine if there is a pattern for higher or lower proficiency at specific ages. Although there may not be sufficient numbers of participants at each age in the present study to draw any firm conclusions, future research could involve recruiting higher numbers of both monolingual and bilingual children at each age to increase generalisability of results.

The results indicating an impact of older chronological age may suggest an advantage for greater cognitive maturity in acquiring specific language structures. However, aside from where short-term memory was shown to impact language measures, the study did not specify which type of cognitive skill was involved in each case. Therefore, future research which includes a broad range of measures of separate cognitive skills associated with older age in childhood (e.g., working memory, executive functioning, attention, and analytic reasoning, etc.), would provide a more comprehensive perspective on the impact of cognition on language development in childhood. Furthermore, results suggested that cognitive skills may be engaged differently depending on the child's stage of language development. Future research investigating their impact from both an earlier stage in development and longitudinally in both bilingual and monolingual development would provide further insights on these effects.

In the current study, socio-economic status was not found to be a predicting factor. However, future research which includes measures of current occupation and educational level for both parents/caregivers (if appropriate) may provide a more precise representation of the family's socio-economic status and in turn, a more accurate picture of this factor's impact on language acquisition for the sequential bilingual population. Additionally, the language in which mothers received their education may also impact results therefore, future research documenting and analysing this would provide further insight on this effect. In relation to maternal L2 proficiency, future research which includes a more formal assessment of the mothers' L2 English may provide more accurate results for this factor.

The lack of variation between participants in relation to motivation meant that we were unable to adequately measure its impact. To provide a more fine-grained measure of children's motivation, future studies could include an interview in which participants (or their parents) are asked questions related to their motivation for learning the L2. This could include their language preference, their attitude towards the L2, the positive or negative factors which affected their L2 learning, how happy they were in relation to their level of proficiency, and reasons for learning the L2 (e.g., Wei, 2016).

6.5.4 Summary of future directions

In summary, future directions in relation to the current study could include the following:

- a measure of refugee status and whether the children had missed schooling;
- a measure of the participants' wellbeing;
- incorporating more than one L1 background, or a higher number of participants with particular L1 dialects, to provide greater insight on the influence of cross-linguistic influence for this population;
- including a larger number of children who are trilingual speakers to investigate whether there are differences in the impact of factors depending on whether children are acquiring English as an L2 or an L3 (trilingual);
- assessing children's proficiency in the equivalent L1 language features (if present) to examine whether knowledge of this feature in the L1 is directly impacting the proficiency of this structure in the L2;
- the inclusion of receptive lexical and morphological tasks and elicitation tasks to probe expressive use of sentences to provide further insight on this population's language proficiency across domains;
- the use of a narrative story retelling task;
- analysing the bilingual child's birth order and the presence of older school-aged siblings to investigate whether these factors impact proficiency or use of language measures;
- measuring a higher number of cognitive abilities (short-term and working memory, attention, theory of mind, executive functioning skills, etc.), the child's current L1 language proficiency, and the content of participants' school curriculums, to pinpoint which type (if any) of these abilities may be driving the older age effect for complex syntax;
- exploring the specific types of L2 activities and play the children are involved in, the types of language users they engage with, and the kinds of language used among the children during these play and social activity settings, to enrich the results on the quality of input and its influence on L2 language proficiency;

- measuring L2 input over the individual's life span (rather than just their current input levels) for each individual input area so that a truer reading of input effects is obtained;
- the inclusion of measures of current occupation and educational level for both parents/caregivers (if appropriate) to provide a more precise representation of the family's socio-economic status;
- documenting and analysing the language in which mothers received their education would provide further insight on the impact of maternal education;
- evaluation of more fine-grained measures of children's L2 use at school by using rating scales (similar to input measures in the ALEQ), e.g., to measure the children's engagement in school activities and sports with the L2 as the language of instruction, how often their play with others involves the L2 as the primary language, how often they interact/play with native-English speakers at school, and how often they engage in L2 literacy activities, and also asking teachers to rate whether/how often particular language features (e.g., complex sentences) are specifically taught/used in the classroom;
- evaluation of more fine-grained measures of children's motivation for learning the L2 by including an interview in which participants (or their parents) are asked questions related to their L2 motivation, e.g., their language preference, their attitude towards the L2, the positive or negative factors which affected their L2 learning, how happy they were in relation to their level of proficiency, and reasons for learning the L2 (e.g., Wei, 2016).

The following chapter will conclude the study's findings.

7. Conclusion

This thesis aimed to identify the individual difference factors which predict language measures which are complex and non-complex in sequential bilingual language acquisition in childhood. The study examined interdependencies between predicting factors and the differences between the sequential bilingual and monolingual participants. Based on the results of the linear regression analyses it can be concluded that specific individual difference factors predict language measures depending on the language population under consideration. Furthermore, particular factors interact with other factors to support language proficiency depending on the complexity of the linguistic feature.

This study has shown that for sequential bilingual children, an older age in childhood, which is associated with greater cognitive ability and overall language experience, facilitates interpretation across complex and non-complex sentence structures (active and passive voice and subject and object relative clauses). While this research clearly illustrates that older ages in childhood are facilitative of greater comprehension of syntax for bilingual children, it also raises the question of what particular feature(s) associated with older age in childhood is driving this. Future research which includes measuring a higher number of cognitive abilities as well as proficiency in both the L1 and L2 is needed to bring further insights on the influence of age and language development. Also, older children may have access to more complex language delivered through the educational curriculum. Future research which includes measuring the content of participants' school curriculums would reveal if older children are exposed to substantially more complex language features through their schooling. In contrast, a younger age of L2 onset did not predict language measures for primary school-aged sequential bilingual children. Despite the established view that 'younger is better' for acquisition of additional languages, results from this study do not support this. However, future research incorporating a wider age of onset range which includes more participants with much younger ages of onset may provide further understanding of the particular stages that age of onset effects manifest. Additionally, to better understand if the older age advantage holds over an extended course of time, future research should consider investigating the proficiency of target structures longitudinally.

While results demonstrated that overall exposure to language is important in the acquisition of vocabulary and morphology, in terms of input and comprehension of syntactic structures, it is exposure through participation in play and social activities, likely involving native-speaking peers, which is important. Results have also shown that a richer language environment further enhances the interpretation of more complex sentences (passive voice and object relative clauses) when children are older. Therefore, when children experience richer input is important. While this suggests that greater participation in play and social activities positively impacts language skills, it raises the question of what specific types of play and social activities, and also what types of language heard/used during these sessions, facilitate this language proficiency. Future research investigating these features would bring further insights on the benefits of this type of language exposure for sequential bilinguals. Based on the findings for richer L2 experiences, practitioners advocating for EAL/newcomer children and their linguistic and educational outcomes or integration within school and the community should consider encouraging greater participation in L2 play and social activities which involve native speakers as a way to support language development.

From a methodological standpoint, the inclusion of separate input measures allowed this study to capture the impact of specific types of exposure (see also: Paradis, 2011; Paradis et al., 2017). While much previous research has measured input as a combined factor including a number of quantitative and qualitative factors, results have been mixed. Therefore, it may be the case that measuring types of input separately allows a more fine-grained insight on the impact of specific types of input in various situations for acquiring an additional language. However, this could be expanded further by incorporating a measure of L2 input which takes account of the individual's input of their life span, as opposed to current input only, so that an even more fine-grained reading of input is obtained.

Short-term memory appears to play a role in processing expressive morphosyntax for sequential bilingual children which may be linked to the greater processing demands bilinguals experience with language phenomena when it interfaces with discourse. Socioeconomic status had no impact on higher language ability however, in the case of sequential bilingual children who are often from refugee or immigrant backgrounds, this measure may require a more nuanced approach. This could involve measuring each parent/caregiver(s)' current occupation and the inclusion of mothers with wider ranges of educational backgrounds.

This research illustrates differences in how factors impact acquisition of language features, but it also raises the question of whether the participants' L1 influences these findings. Future research comprising participants from other L1 backgrounds and including the language background as a predicting factor in the analysis will bring further insight on the influence of the first language on second language proficiency. One specific language feature to examine in relation to Arabic speakers is passive voice. The structure of the passive voice in Arabic diverges from English in that the passive voice never contains an adjunct argument referring to the agent. That is, the equivalent of a by-phrase is not available; only short passives are possible in Arabic (Alsadi, 2017). Therefore, this finding may be explained by cross-linguistic influence from Arabic. Comparing Arabic speaking children's interpretations with those of children whose first language requires an obligatory by-phrase and agent form, such as Cantonese, could bring more insight on the presence of L1 influence for this language feature.

While length of L2 exposure predicted vocabulary and morphology for the bilingual children, it was chronological age which predicted the same language features for the monolingual children. However, chronological age for the monolinguals could also be interpreted as a proxy for their length of exposure to English: the older the age of monolinguals, the longer overall exposure time they will have had to English. Chronological age also predicted production rather than interpretation of sentences for the monolinguals whereas short-term memory predicted interpretation as opposed to production of syntax. This could suggest differences in how language is processed in monolingual versus bilingual acquisition.

With the growth of immigrant populations worldwide, the numbers of sequential bilingual children have increased significantly (Murphy & Evangelou, 2016). Acquisition of the societal language is crucial for this population's integration into all aspects of the school environment such as accessing the school curriculum, academic achievement, and interacting socially with peers and friends as well as the wider majority ethnolinguistic community (Murphy & Evangelou, 2016). In terms of schooling, this becomes even more critical as many sequential bilingual children who are newcomer children show low attainment in educational qualifications compared to non-newcomer children (Department of Education (NI), 2009; Hutchinson, 2018; Mahon & Crutchley, 2006). A better understanding of sequential bilingualism and the factors which impact it has the potential to help teachers and teaching assistants prepare, adapt, and deliver more appropriate classroom activities and materials which ultimately better facilitate the educational progress and outcomes of newcomer pupils (Paradis, 2011).

In conclusion, this study builds on valuable previous research investigating individual differences in sequential bilingualism. By teasing apart the impact of factors, the study provides further insights on the effect of these factors across linguistic domains and features. It also provides novel findings on how predictors interact to impact language proficiency, and it demonstrates the value of a comparative analysis of a number of individual factors in the study of bilingualism.

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Appendix A: Countries of origin and background languages of sequential bilingual participants

Participant number	Country of origin	Languages known	Participant number	Country of origin	Languages known
6	United Arab Emirates	Arabic	33	Libya	Arabic
8	Jordan	Arabic	34	Sudan	Arabic
9	Jordan	Arabic	36	Syria	Arabic
10	Morocco	Arabic	37	Syria	Arabic
11	United Arab Emirates	Arabic	39	Jordan	Arabic
12	Jordan	Arabic	40	Saudi Arabia	Arabic
19	Saudi Arabia	Arabic	42	Palestine	Arabic
20	Iraq	Arabic	43	Kuwait	Arabic
21	Jordan	Arabic	49	Morocco	Arabic
22	Algeria	Arabic	55	Egypt	Arabic
23	Sudan	Arabic	71	Syria	Arabic
24	Iraq	Arabic	72	Sudan	Arabic
25	Syria	Arabic	73	Sudan	Arabic
26	Algeria	Arabic/French	78	Egypt	Arabic
27	Algeria	Arabic/French	81	Syria	Arabic
28	Libya	Arabic	82	Syria	Arabic
29	Syria	Arabic/Kurdish	83	Syria	Arabic
30	Sudan	Arabic	84	Egypt	Arabic
31	Syria	Arabic/Kurdish	89	Somalia	Arabic/Somalian
32	Syria	Arabic/Kurdish	90	Somalia	Arabic/Somalian

Appendix B: Test items used for the Coloring Book task

Set 1

'Hi [child's name], do you like to colour?' [wait for response]

'My friend Joey sent me this colouring game, and he wants us to colour in a few things for him. And Joey told me what he wants us to colour, so if I tell you what Joey told me, do you want to colour them in?'

[wait for response]

1. Training 1: Ok, so in this picture there's a strawberry and grapes. Let's choose a colour now. The strawberry is <chosen colour>.
2. Training 2: Ok, so in this picture there's a teddy bear, train and a doll. Let's choose a colour now. The train is <chosen colour>.
3. Training 3: Ok, so in this picture there's a mouse, a puppy and a kitten. Let's choose a colour now. The <chosen colour> kitten has a feather.
4. Active: Ok, so in this picture there's a dog, a leopard, and another dog. Let's choose a colour now. The leopard chased the <colour> dog.
5. Filler: Ok, so in this picture there's a giraffe, another giraffe, and another giraffe. Let's choose a colour now. The <colour> giraffe rode a bicycle.
6. Passive: Ok, so in this picture there's a duck, a hippo, and another duck. Let's choose a colour now. The duck was pulled by the colour hippo.
7. Filler: Ok, so in this picture there's a goat, another goat, and another goat. Let's choose a colour now. The <colour> goat built a fence.
8. Passive: Ok, so in this picture there's a dolphin, a cat, and another dolphin. Let's choose a colour now. The cat was kissed by the colour dolphin.
9. Filler: Ok, so in this picture there's a dog, a panda, and a shark. Let's choose a colour now. The <colour> animal flew a kite.
10. Active: Ok, so in this picture there's a sheep, a cow, and another sheep. Let's choose a colour now. The cow washed the <colour> sheep.
11. Filler: Ok, so in this picture there's a dolphin, a frog, and a kangaroo. Let's choose a colour now. The <colour> animal read a newspaper.
12. Active: Ok, so in this picture there's a hedgehog, a squirrel, and another hedgehog. Let's choose a colour now. The squirrel painted the <colour> hedgehog.
13. Filler: Ok, so in this picture there's a duck, a zebra, and a penguin. Let's choose a colour now. The <colour> animal played the drums.

14. Passive: Ok, so in this picture there's a bear, a deer and another bear. Let's choose a colour now. The deer was combed by the <colour> bear.
15. Filler: Ok, so in this picture there's a cow, another cow, and another cow. Let's choose a colour now. The <colour> cow picked a leaf.
16. Active: Ok, so in this picture there's a frog, a monkey, and another frog. Let's choose a colour now. The monkey buried the <colour> frog.
17. Filler: Ok, so in this picture there's a rabbit, a pig, and a bird. Let's choose a colour now. The <colour> animal drew a sun.
18. Filler: Ok, so in this picture there's a leopard, another leopard, and another leopard. Let's choose a colour now. The <colour> leopard ate a cupcake.
19. Active: Ok, so in this picture there's a goat, a donkey, and another goat. Let's choose a colour now. The donkey kicked the <colour> goat.
20. Filler: Ok, so in this picture there's a squirrel, another squirrel, and another squirrel. Let's choose a colour now. The <colour> squirrel climbed a ladder.
21. Passive: Ok, so in this picture there's a kangaroo, a seal and another kangaroo. Let's choose a colour now. The seal was sprayed by the <colour> kangaroo.
22. Filler: Ok, so in this picture there's a cat, a fox, and a monkey. Let's choose a colour now. The <colour> animal drank the milk.
23. Active: Ok, so in this picture there's a crocodile, a shark, and another crocodile. Let's choose a colour now. The shark bit the <colour> crocodile.
24. Filler: Ok, so in this picture there's a donkey, another donkey, and another donkey. Let's choose a colour now. The <colour> donkey wore a scarf.
25. Passive: Ok, so in this picture there's a giraffe, a lion and another giraffe. Let's choose a colour now. The lion was followed by the <colour> giraffe.
26. Filler: Ok, so in this picture there's an owl, another owl, and another owl. Let's choose a colour now. The <colour> owl held a spoon.
27. Passive: Ok, so in this picture there's a zebra, a panda and another zebra. Let's choose a colour now. The panda was fanned by the <colour> zebra.
28. Filler: Ok, so in this picture there's a koala, a sheep, and a crocodile. Let's choose a colour now. The <colour> animal used scissors.
29. Active: Ok, so in this picture there's a horse, a pig, and another horse. Let's choose a colour now. The pig caught the <colour> horse.
30. Filler: Ok, so in this picture there's a hedgehog, a bear, and a seal. Let's choose a colour now. The <colour> animal drove the tractor.
31. Passive: Ok, so in this picture there's a bird, a rabbit and another bird. Let's choose a colour now. The rabbit was carried by the <colour> bird.

32. Filler: Ok, so in this picture there's a hippo, a horse, and a lion. Let's choose a colour now. The <colour> animal cleaned the clothes.
33. Active: Ok, so in this picture there's a fox, an owl, and another fox. Let's choose a colour now. The owl brushed the <colour> fox.
34. Filler: Ok, so in this picture there's a deer, another deer, and another deer. Let's choose a colour now. The <colour> deer threw the football.
35. Passive: Ok, so in this picture there's a penguin, a koala and another penguin. Let's choose a colour now. The koala was covered by the <colour> penguin.
36. Subject: Ok, so in this picture there's a rabbit, a horse and another rabbit. Something here is <colour>. Let's choose a colour now. Oh look, it's <u>the rabbit</u> that pulled the horse.
37. Filler: Ok, so in this picture there's a dog, another dog, and another dog. Something here is <colour>. Let's choose a colour now. Oh look, it wore a hat.
38. Object: Ok, so in this picture there's a shark, a bird and another shark. Something here is <colour>. Let's choose a colour now. Oh look, it's the shark that the bird buried.
39. Filler: Ok, so in this picture there's a pig, a goat, and a shark. Something here is <colour>. Let's choose a colour now. Oh look, it threw a snowball.
40. Subject: Ok, so in this picture there's a deer, a hedgehog and another deer. Something here is <colour>. Let's choose a colour now. Oh look, it's the deer that kissed the hedgehog.
41. Filler: Ok, so in this picture there's a panda, a bird, and another panda. Something here is <colour>. Let's choose a colour now. Oh look, it read a book.
42. Filler: Ok, so in this picture there's a hedgehog, a cow, and a bear. Something here is <colour>. Let's choose a colour now. Oh look, it climbed the mountain.
43. Subject: Ok, so in this picture there's a squirrel, a sheep and another squirrel. Something here is <colour>. Let's choose a colour now. Oh look, it's the squirrel that combed the sheep.
44. Filler: Ok, so in this picture there's a rabbit, another rabbit, and another rabbit. Something here is <colour>. Let's choose a colour now. Oh look, it used the paintbrush.

45. Object:Ok, so in this picture there's a cat, a penguin and another cat. Something here is <colour>. Let's choose a colour now. Oh look, it's the cat that the penguin washed.

46. Filler: Ok, so in this picture there's a sheep, another sheep, and another sheep. Something here is <colour>. Let's choose a colour now. Oh look, it picked a flower.

47. Object: Ok, so in this picture there's a duck, a crocodile and another duck. Something here is <colour>. Let's choose a colour now. Oh look, it's the duck that the crocodile painted.

48. Filler: Ok, so in this picture there's a donkey, a dolphin, and a kangaroo. Something here is <colour>. Let's choose a colour now. Oh look, it drove a bus.

49. Subject: Ok, so in this picture there's a monkey, a dog and another monkey. Something here is <colour>. Let's choose a colour now. Oh look, it's the monkey that sprayed the dog.

50. Filler: Ok, so in this picture there's a zebra, a squirrel, and a duck. Something here is <colour>. Let's choose a colour now. Oh look, it held a spoon.

51. Object: Ok, so in this picture there's a donkey, a hippo and another donkey. Something here is <colour>. Let's choose a colour now. Oh look, it's the donkey that the hippo chased.

52. Filler: Ok, so in this picture there's a monkey, another monkey, and another monkey. Something here is <colour>. Let's choose a colour now. Oh look, it played the piano.

53. Subject: Ok, so in this picture there's a koala, a frog and another koala. Something here is <colour>. Let's choose a colour now. Oh look, it's the koala that fanned the frog.

54. Filler: Ok, so in this picture there's a crocodile, a koala, and a giraffe. Something here is <colour>. Let's choose a colour now. Oh look, it drew a boat.

55. Object: Ok, so in this picture there's a cow, a kangaroo and another cow. Something here is <colour>. Let's choose a colour now. Oh look, it's the cow that the kangaroo kicked.

56. Filler: Ok, so in this picture there's a penguin, another penguin, and another penguin. Something here is <colour>. Let's choose a colour now. Oh look, it rode a motorcycle.

57. Subject: Ok, so in this picture there's a koala, a frog and another koala. Something here is <colour>. Let's choose a colour now. Oh look, it's the pig that followed the bear.

58. Filler: Ok, so in this picture there's a seal, another seal, and another seal. Something here is <colour>. Let's choose a colour now. Oh look, it flew an airplane.

59. Subject: Ok, so in this picture there's an owl, a zebra and another owl. Something here is <colour>. Let's choose a colour now. Oh look, it's the owl that carried the zebra.

60. Filler: Ok, so in this picture there's a frog, another frog, and another frog. Something here is <colour>. Let's choose a colour now. Oh look, it drank the juice.

61. Object: Ok, so in this picture there's a panda, a goat and another panda. Something here is <colour>. Let's choose a colour now. Oh look, it's the panda that the goat brushed.

62. Filler: Ok, so in this picture there's a fox, an owl, and a cat. Something here is <colour>. Let's choose a colour now. Oh look, it cleaned the windows.

63. Subject: Ok, so in this picture there's a leopard, a giraffe and another leopard. Something here is <colour>. Let's choose a colour now. Oh look, it's the leopard that covered the giraffe.

64. Filler: Ok, so in this picture there's a horse, another horse, and another horse. Something here is <colour>. Let's choose a colour now. Oh look, it ate an ice-cream.

65. Object: Ok, so in this picture there's a lion, a fox and another lion. Something here is <colour>. Let's choose a colour now. Oh look, it's the lion that the fox bit.

66. Filler: Ok, so in this picture there's a leopard, a hippo, and a lion. Something here is <colour>. Let's choose a colour now. Oh look, it built a table.

67. Object: Ok, so in this picture there's a dolphin, a seal and another dolphin. Something here is <colour>. Let's choose a colour now. Oh look, it's the dolphin that the seal caught.

Set 2

'Hi [child's name], do you like to colour?' [wait for response]

'My friend Joey sent me this colouring game, and he wants us to colour in a few things for him. And Joey told me what he wants us to colour, so if I tell you what Joey told me, do you want to colour them in?'

[wait for response]

1. Training 1: Ok, so in this picture there's a strawberry and grapes. Let's choose a colour now. The strawberry is <chosen colour>.

2. Training 2: Ok, so in this picture there's a teddy bear, train and a doll. Let's choose a colour now. The train is <chosen colour>.

3. Training 3: Ok, so in this picture there's a mouse, a puppy and a kitten. Let's choose a colour now. The <chosen colour> kitten has a feather.

4. Subject: Ok, so in this picture there's a rabbit, a horse and another rabbit. Something here is <colour>. Let's choose a colour now. Oh look, it's the rabbit that pulled the horse.

5. Filler: Ok, so in this picture there's a dog, another dog, and another dog. Something here is <colour>. Let's choose a colour now. Oh look, it wore a hat.

6. Object: Ok, so in this picture there's a shark, a bird and another shark. Something here is <colour>. Let's choose a colour now. Oh look, it's the shark that the bird buried.

7. Filler: Ok, so in this picture there's a pig, a goat, and a shark. Something here is <colour>. Let's choose a colour now. Oh look, it threw a snowball.

8. Subject: Ok, so in this picture there's a deer, a hedgehog and another deer. Something here is <colour>. Let's choose a colour now. Oh look, it's the deer that kissed the hedgehog.

9. Filler: Ok, so in this picture there's a panda, a bird, and another panda. Something here is <colour>. Let's choose a colour now. Oh look, it read a book.

10. Filler: Ok, so in this picture there's a hedgehog, a cow, and a bear. Something here is <colour>. Let's choose a colour now. Oh look, it climbed the mountain.

11. Subject: Ok, so in this picture there’s a squirrel, a sheep and another squirrel. Something here is <colour>. Let’s choose a colour now. Oh look, it’s the squirrel that combed the sheep.

12. Filler: Ok, so in this picture there’s a rabbit, another rabbit, and another rabbit. Something here is <colour>. Let’s choose a colour now. Oh look, it used the paintbrush.
13. Object:Ok, so in this picture there’s a cat, a penguin and another cat. Something here is <colour>. Let’s choose a colour now. Oh look, it’s the cat that the penguin washed.

14. Filler: Ok, so in this picture there’s a sheep, another sheep, and another sheep. Something here is <colour>. Let’s choose a colour now. Oh look, it picked a flower.

15. Object: Ok, so in this picture there’s a duck, a crocodile and another duck. Something here is <colour>. Let’s choose a colour now. Oh look, it’s the duck that the crocodile painted.

16. Filler: Ok, so in this picture there’s a donkey, a dolphin, and a kangaroo. Something here is <colour>. Let’s choose a colour now. Oh look, it drove a bus.

17. Subject: Ok, so in this picture there’s a monkey, a dog and another monkey. Something here is <colour>. Let’s choose a colour now. Oh look, it’s the monkey that sprayed the dog.

18. Filler: Ok, so in this picture there’s a zebra, a squirrel, and a duck. Something here is <colour>. Let’s choose a colour now. Oh look, it held a spoon.

19. Object: Ok, so in this picture there’s a donkey, a hippo and another donkey. Something here is <colour>. Let’s choose a colour now. Oh look, it’s the donkey that the hippo chased.

20. Filler: Ok, so in this picture there’s a monkey, another monkey, and another monkey. Something here is <colour>. Let’s choose a colour now. Oh look, it played the piano.

21. Subject: Ok, so in this picture there’s a koala, a frog and another koala. Something here is <colour>. Let’s choose a colour now. Oh look, it’s the koala that fanned the frog.

22. Filler: Ok, so in this picture there’s a crocodile, a koala, and a giraffe. Something here is <colour>. Let’s choose a colour now. Oh look, it drew a boat.

23. Object: Ok, so in this picture there's a cow, a kangaroo and another cow. Something here is <colour>. Let's choose a colour now. Oh look, it's the cow that the kangaroo kicked.

24. Filler: Ok, so in this picture there's a penguin, another penguin, and another penguin. Something here is <colour>. Let's choose a colour now. Oh look, it rode a motorcycle.

25. Subject: Ok, so in this picture there's a koala, a frog and another koala. Something here is <colour>. Let's choose a colour now. Oh look, it's the pig that followed the bear.

26. Filler: Ok, so in this picture there's a seal, another seal, and another seal. Something here is <colour>. Let's choose a colour now. Oh look, it flew an airplane.

27. Subject: Ok, so in this picture there's an owl, a zebra and another owl. Something here is <colour>. Let's choose a colour now. Oh look, it's the owl that carried the zebra.

28. Filler: Ok, so in this picture there's a frog, another frog, and another frog. Something here is <colour>. Let's choose a colour now. Oh look, it drank the juice.

29. Object: Ok, so in this picture there's a panda, a goat and another panda. Something here is <colour>. Let's choose a colour now. Oh look, it's the panda that the goat brushed.

30. Filler: Ok, so in this picture there's a fox, an owl, and a cat. Something here is <colour>. Let's choose a colour now. Oh look, it cleaned the windows.

31. Subject: Ok, so in this picture there's a leopard, a giraffe and another leopard. Something here is <colour>. Let's choose a colour now. Oh look, it's the leopard that covered the giraffe.

32. Filler: Ok, so in this picture there's a horse, another horse, and another horse. Something here is <colour>. Let's choose a colour now. Oh look, it ate an ice-cream.

33. Object: Ok, so in this picture there's a lion, a fox and another lion. Something here is <colour>. Let's choose a colour now. Oh look, it's the lion that the fox bit.

34. Filler: Ok, so in this picture there's a leopard, a hippo, and a lion. Something here is <colour>. Let's choose a colour now. Oh look, it built a table.

35. Object: Ok, so in this picture there's a dolphin, a seal and another dolphin. Something here is <colour>. Let's choose a colour now. Oh look, it's the dolphin that the seal caught.

36. Active: Ok, so in this picture there's a dog, a leopard, and another dog. Let's choose a colour now. The leopard chased the <colour> dog.

37. Filler: Ok, so in this picture there's a giraffe, another giraffe, and another giraffe. Let's choose a colour now. The <colour> giraffe rode a bicycle.

38. Passive: Ok, so in this picture there's a duck, a hippo, and another duck. Let's choose a colour now. The duck was pulled by the colour hippo.

39. Filler: Ok, so in this picture there's a goat, another goat, and another goat. Let's choose a colour now. The <colour> goat built a fence.

40. Passive: Ok, so in this picture there's a dolphin, a cat, and another dolphin. Let's choose a colour now. The cat was kissed by the colour dolphin.

41. Filler: Ok, so in this picture there's a dog, a panda, and a shark. Let's choose a colour now. The <colour> animal flew a kite.

42. Active: Ok, so in this picture there's a sheep, a cow, and another sheep. Let's choose a colour now. The cow washed the <colour> sheep.

43. Filler: Ok, so in this picture there's a dolphin, a frog, and a kangaroo. Let's choose a colour now. The <colour> animal read a newspaper.

44. Active: Ok, so in this picture there's a hedgehog, a squirrel, and another hedgehog. Let's choose a colour now. The squirrel painted the <colour> hedgehog.

45. Filler: Ok, so in this picture there's a duck, a zebra, and a penguin. Let's choose a colour now. The <colour> animal played the drums.

46. Passive: Ok, so in this picture there's a bear, a deer and another bear. Let's choose a colour now. The deer was combed by the <colour> bear.

47. Filler: Ok, so in this picture there's a cow, another cow, and another cow. Let's choose a colour now. The <colour> cow picked a leaf.

48. Active: Ok, so in this picture there's a frog, a monkey, and another frog. Let's choose a colour now. The monkey buried the <colour> frog.

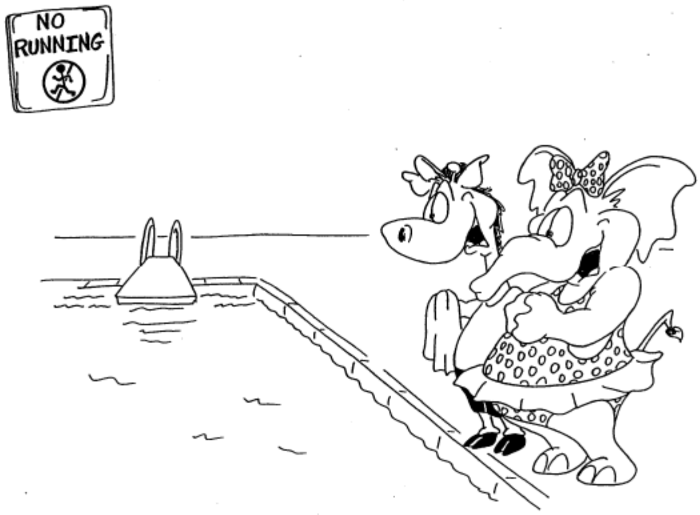
49. Filler: Ok, so in this picture there's a rabbit, a pig, and a bird. Let's choose a colour now. The <colour> animal drew a sun.

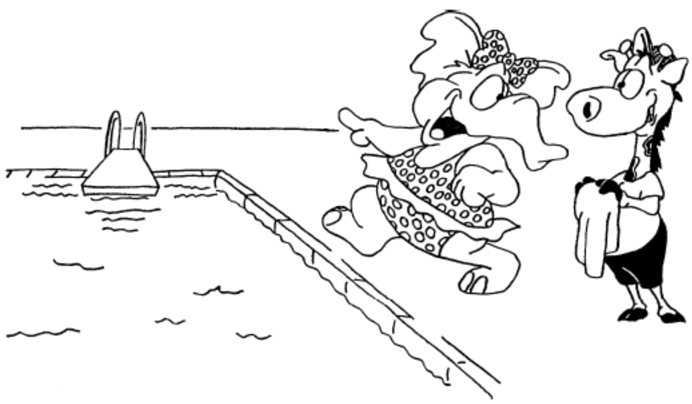
50. Filler: Ok, so in this picture there's a leopard, another leopard, and another leopard. Let's choose a colour now. The <colour> leopard ate a cupcake.

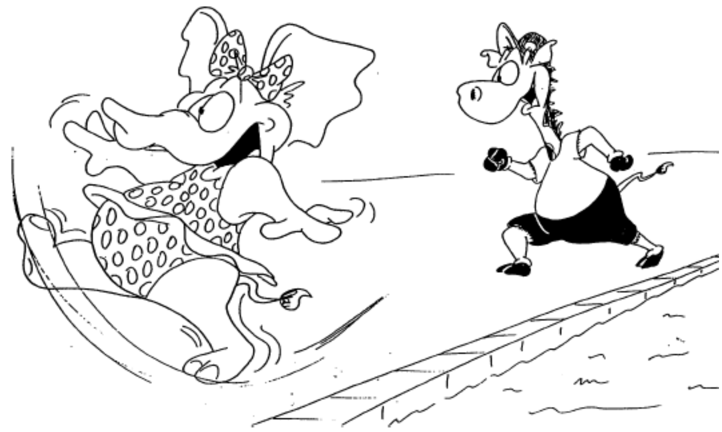
51. Active: Ok, so in this picture there's a goat, a donkey, and another goat. Let's choose a colour now. The donkey kicked the <colour> goat.

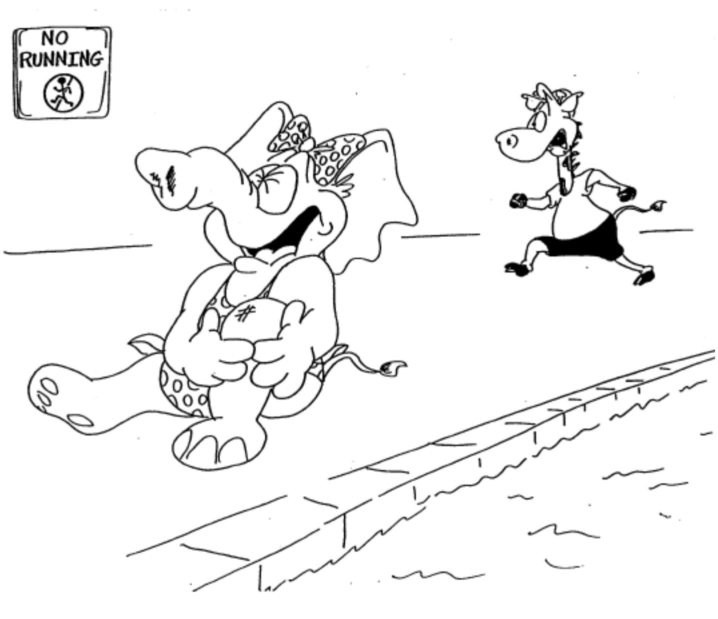
52. Filler: Ok, so in this picture there's a squirrel, another squirrel, and another squirrel. Let's choose a colour now. The <colour> squirrel climbed a ladder.
53. Passive: Ok, so in this picture there's a kangaroo, a seal and another kangaroo. Let's choose a colour now. The seal was sprayed by the <colour> kangaroo.
54. Filler: Ok, so in this picture there's a cat, a fox, and a monkey. Let's choose a colour now. The <colour> animal drank the milk.
55. Active: Ok, so in this picture there's a crocodile, a shark, and another crocodile. Let's choose a colour now. The shark bit the <colour> crocodile.
56. Filler: Ok, so in this picture there's a donkey, another donkey, and another donkey. Let's choose a colour now. The <colour> donkey wore a scarf.
57. Passive: Ok, so in this picture there's a giraffe, a lion and another giraffe. Let's choose a colour now. The lion was followed by the <colour> giraffe.
58. Filler: Ok, so in this picture there's an owl, another owl, and another owl. Let's choose a colour now. The <colour> owl held a spoon.
59. Passive: Ok, so in this picture there's a zebra, a panda and another zebra. Let's choose a colour now. The panda was fanned by the <colour> zebra.
60. Filler: Ok, so in this picture there's a koala, a sheep, and a crocodile. Let's choose a colour now. The <colour> animal used scissors.
61. Active: Ok, so in this picture there's a horse, a pig, and another horse. Let's choose a colour now. The pig caught the <colour> horse.
62. Filler: Ok, so in this picture there's a hedgehog, a bear, and a seal. Let's choose a colour now. The <colour> animal drove the tractor.
63. Passive: Ok, so in this picture there's a bird, a rabbit and another bird. Let's choose a colour now. The rabbit was carried by the <colour> bird.
64. Filler: Ok, so in this picture there's a hippo, a horse, and a lion. Let's choose a colour now. The <colour> animal cleaned the clothes.
65. Active: Ok, so in this picture there's a fox, an owl, and another fox. Let's choose a colour now. The owl brushed the <colour> fox.
66. Filler: Ok, so in this picture there's a deer, another deer, and another deer. Let's choose a colour now. The <colour> deer threw the football.
67. Passive: Ok, so in this picture there's a penguin, a koala and another penguin. Let's choose a colour now. The koala was covered by the <colour> penguin.

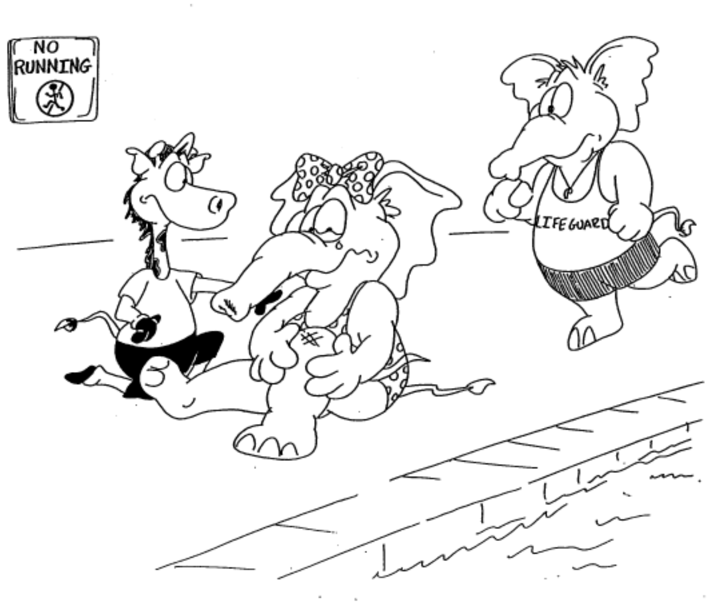
Appendix C: Narrative Task Pictures
(Story A2, The Edmonton Narrative Norms Instrument; ENNI, Schneider, Dubé & Hayward, 2005)



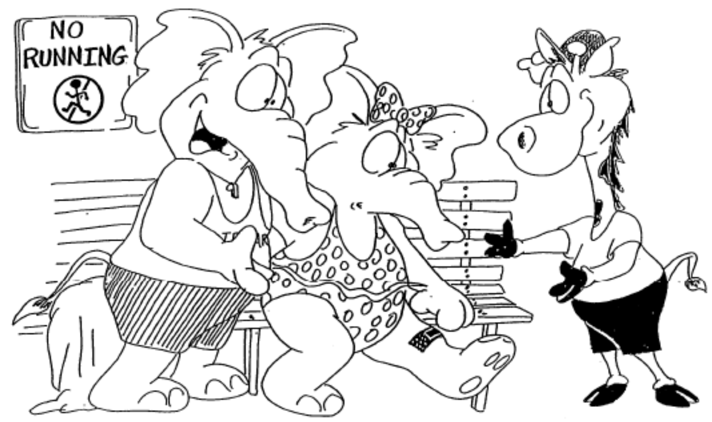


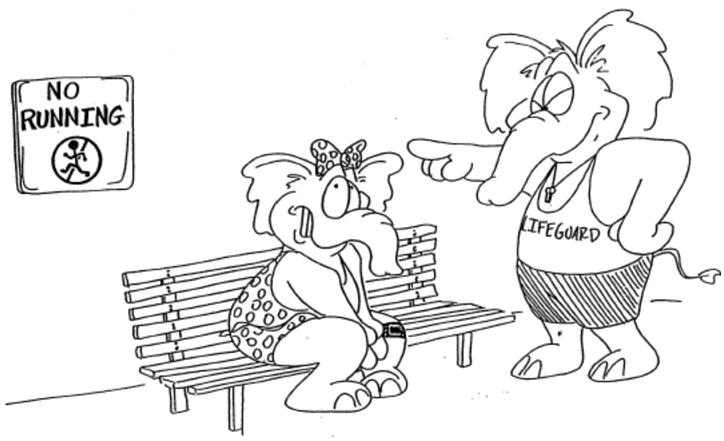



NO
RUNNING


NO
RUNNING
LIFEGUARD


NO
RUNNING


NO
RUNNING


NO
RUNNING
LIFEGUARD

Appendix D: Parent questionnaire

(English version)

Name of child: ____
Date of birth of child: ____
Gender of child: ____

A. Questions to the child's MOTHER:

1a. How many years have you been in Northern Ireland? _______________
Approximate date of arrival (month/year)? ______________

1b. Did your child come to Northern Ireland (NI) at the same time? Yes No

If not, when did your child come to NI? __________________

2. How much English do you speak? (Choose a number/description below)

1	2	3	4	5
No English	Limited English	Some Fluency in English	Quite Fluent in English	Very Fluent in English
No understanding or speaking ability	Some understanding and can say short, simple sentences	Good understanding and can express myself on many topics	Can understand and use English adequately for work and most other situations	Understand almost everything. Very comfortable expressing myself in English in all situations
	e.g. can answer the phone in English	e.g. can go to the doctor and explain what is wrong	e.g. can communicate effectively with teachers at parent teacher interviews; could work in the service-industry; can follow movies or television shows	

3. What language(s) do you speak with your child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

4. What language(s) does your child speak with you?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

5. What language do you speak most often with the other people in your home?

0	4
More Mother Tongue	More English

6a. Are you a student or work outside the home? Yes No

6b. If yes, is the language of the workplace/school English? (Choose a number/description below)

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

7. How many years of education do you have (including home country and NI)?

Education	Completed?	Number of years completed
Primary	Yes No	
Secondary	Yes No	
Higher Educational Institution	Yes No	
University – Degree	Yes No	
University – Master	Yes No	
University – PhD	Yes No	

B. Questions to parents about OTHER FAMILY MEMBERS in the home

8a. Are there other adult relatives in the home? For example, a father or grandmother?

Yes No

8b. If yes, how many? _________

9. If yes, is one of these adults your child's main caregiver?

Yes No

10. If yes, what language(s) does the main caregiver speak with your child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

11. If applicable, what language(s) does your child speak with the main caregiver?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

12a. If there are other adults in the home (who are not the main caregiver), do they regularly interact with your child? Yes No

12b. If yes, what language(s) does the adult relative(s) speak with your child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

13. If applicable, what language(s) does your child speak with the adult relative(s) (who are not the main care giver)?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

14. Does your child have brothers or sisters? Yes No

If yes, how many? _____________

15. Brother/sister (1): Older Younger

Gender: M F

Date of Birth: ______________________

16. What language(s) does this brother/sister (1) speak with the child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

17. What language(s) does the child speak with this brother/sister (1)?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

18. Brother/sister (2) Older Younger

Gender: M F

Date of Birth: ______________________

19. What language(s) does this brother/sister (2) speak with the child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

20. What language(s) does the child speak with his/her brother/sister (2)?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

C. Questions to parents about the your CHILD

21. At what age did your child start receiving consistent and significant exposure to English?

Age: ______

Consistent and significant = English-language day-care/nursery or babysitter full-time or at least three days per week or equivalent part-time. English-language school of any kind counts as consistent and significant exposure.

22. Does your child attend any activities after school or outside of school?

	every day	At least once a week	almost never/ never
English:	2	1	0

23. What are the languages spoken between your child and the friends he/she plays with regularly?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

D. Additional brothers/sisters (if any):

24. Brother/sister (3) Older Younger

Gender: M F

Date of Birth: ______________________

25. What language(s) does this sibling (3) speak with the child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

26. What language(s) does the child speak with his/her sibling (3)?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

27. Brother/sister (4) Older Younger

Gender: M F

Date of Birth: ________________________

28. What language(s) does this brother/sister (4) speak with the child?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

29. What language(s) does the child speak with his/her brother/sister (4)?

1	2	3	4	5
Mother tongue only	More Mother tongue	English 50% Mother tongue 50%	More English	English only

Calculation for L2 language use at home was completed using the following guideline example (question numbers may be different to the adapted parent questionnaire above however the scoring was completed in the same way):

	SCORE	EXAMPLE		SCORE	EXAMPLE
Mother to Child (Question 3)		1	Child to Mother (Question 4)		3
Father to Child (Question 10)		1	Child to Father (Question 11)		3
Other Adult to Child (Primary Caregiver) (Question 17)		NA	Child to Other Adult (Primary Caregiver) (Question 18)		NA
Other Adult to Child * (not Primary Caregiver) (Question 19b)		NA	Child to Other Adult * (not Primary Caregiver) (Question 20)		NA
Sibling 1 to Child ** (Question 23)		3	Child to Sibling 1 ** (Question 24)		4
Sibling 2 to Child ** (Question 26)		NA	Child to Sibling 2 ** (Question 27)		NA
Additional Sibling(s) to Child **/*** (Appendix)		NA	Child to Additional Sibling(s) **/*** (Appendix)		NA
TOTAL: *Sum of scores* / *Number of scores x 4*		5/12	**TOTAL:** *Sum of scores* / *Number of scores x 4*		10/12

To Calculate Language Use in the Home:

Add both totals together and then divide to get a proportion score:

$$\frac{\boxed{} + \boxed{} = \boxed{}}{\boxed{} + \boxed{} = \boxed{}} = \boxed{}$$

Example:

$$\frac{\boxed{5} + \boxed{10} = \boxed{15}}{\boxed{12} + \boxed{12} = \boxed{24}} = \boxed{0.63}$$

(Taken directly from the ALEQ, Paradis, nd; Paradis, 2011)

Calculation for Richness of the L2 environment:

Question 22 score = rating score divided by 2 to give a proportional score.

Question 23 score = rating score divided by 4 to give a proportional score.

The rating scores and the denominators were summed. Then the resulting fraction was divided to generate the Richness of the L2 environment score.

Example score:

Question 22 score = 2 (rating score)/2 (denominator), Question 23 score = 3 (rating score) /4 (denominator).

Equals 5 (sum of rating scores) /7 (sum of denominators) = 0.71

Appendix E: Teacher questionnaire

1. Student’s native language: ________________________

2. Student’s age of arrival in Northern Ireland? _________ Or if unknown, age they commenced at current school? _________

3. Percent of the time that the student uses English in school: ____________%

4. How would you rate the student’s motivation for learning English on a scale of 1-5 (1=low motivation and 5=very high motivation)? _________________

5. How would you rate the student’s overall academic ability on a scale of 1-5 (1=low ability and 5=very high ability)? _________________

Appendix F: Chronological ages, lengths of L2 exposure and ages of first meaningful L2 exposure for the sequential bilingual participants

Participant (sequential bilinguals)	Chronological age (months)	Length of L2 exposure (months)	Age of first meaningful L2 exposure (months)
6	135	99	36
8	133	128	5
9	129	105	24
10	125	101	24
11	115	79	36
12	108	36	72
19	75	31	44
20	97	49	48
21	69	33	36
22	75	63	12
23	76	52	24
24	76	16	60
25	84	42	42
26	80	44	36
27	87	57	30
28	73	37	36
29	123	22	101

30	138	42	96
31	147	27	120
32	108	26	82
33	93	33	60
34	99	75	24
36	72	12	60
37	104	20	84
39	93	33	60
40	102	66	36
42	85	61	24
43	123	63	60
49	69	57	12
55	84	36	48
71	109	61	48
72	134	62	72
73	101	65	36
78	76	40	36
81	121	13	108
82	121	37	84
83	120	7	113
84	85	61	24

89	124	76	48
90	72	24	48

Appendix G: Correlation analysis (correlation coefficients – r-values) between final predictor variables

	Chronological age	Length of L2 exposure	Short-term memory	Richness of the L2 environment	Socio-economic status
Chronological age					
Length of L2 exposure	.35.				
Short-term memory	.39.	.11			
Richness of the L2 environment	.18	.29	.08		
Socio-economic status	-0.18	.49.	-0.1	.15	

'***' Correlation coefficient between 0.9 and 1.0 (very high correlation); '**'correlation coefficient between 0.7 and 0.9 (high correlation); '*' correlation coefficient between 0.5 and 0.7 (moderate correlation); '.' correlation coefficient between 0.3 and 0.5 (low correlation); ' ' correlation coefficients less than 0.3 (little if any correlation) (Calkins, 2005).

Appendix H: R code used for statistical analyses

```
library(lme4)
library(lmtest)
```

Generalised linear model with all fixed effects (all predictors):

```
full_model <- glmer(accuracy ~ age + loe + memory + L2rich + ses + (1|subject)+
(1|item) + (1|school), family=binomial(link="logit"),
control=glmerControl(optimizer="bobyqa", optCtrl=list(maxfun=1e6)),
data=subset(data, linguistic_measure =="linguistic_measure"))
```

Restricted generalised linear model example with all fixed effects (predictors) less one:

```
restricted_model <- glmer(accuracy ~ loe + memory + L2rich + ses + (1|subject)+
(1|item) + (1|school), family=binomial(link="logit"),
control=glmerControl(optimizer="bobyqa", optCtrl=list(maxfun=1e6)),
data=subset(data, linguistic_measure =="linguistic_measure"))
```

Model with chronological age, richness of the L2 environment, and the interaction as fixed effects (example):

```
Interaction_model <- glmer(accuracy ~ age:L2rich + age + L2rich + (1|subject)+
(1|item), family=binomial(link="logit"),control=glmerControl(optimizer="bobyqa",
optCtrl=list(maxfun=1e6)), data=subset(data, linguistic_measure ==" 
linguistic_measure "))
```

Likelihood ratio test between nested models (example):

```
lrtest(full_model, restricted_model)
```

To obtain coefficient estimates, z-values, and p-values:

```
summary(final_model)
```

Code for interaction plot with the interaction model for chronological age and richness of the L2 environment (example):

```
interact_plot(interaction_model, pred = L2rich, modx = chronological age)+
  labs(x = "Richness of the L2 environment", y = "Accuracy in use of past tense") +
  theme(axis.title=element_text(size=16))
```

Appendix I: A comparison of the trilingual children's language scores against mean scores for the sequential bilinguals

Trilingual children (n=8) Participant number	**Language measure**								
Participant number	**Active voice**	**Passive voice**	**Subject relatives**	**Object relatives**	**Vocabulary**	**Third person singular**	**Past tense**	**MLU in narratives**	**Embedded clauses in narratives**
22	0.88	0.63	0.88	0.25	0.55	0.80	0.61	0.16	1.00
26	0.75	0.25	0.63	0.50	0.61	1.00	0.83	0.24	1.00
27	1.00	0.75	1.00	0.63	0.78	1.00	0.94	0.37	1.38
29	0.88	0.88	0.88	0.50	0.50	1.00	1.00	0.08	1.13
31	1.00	1.00	1.00	1.00	0.64	1.00	0.89	0.60	1.50
32	0.75	0.00	0.88	0.63	0.34	1.00	0.89	0.48	1.71
89	0.13	0.50	0.88	0.13	0.60	1.00	0.94	0.42	1.88
90	0.88	0.25	0.88	0.13	0.38	0.60	0.28	0.32	1.00
Mean participant score (sequential bilinguals)	**0.82**	**0.65**	**0.87**	**0.63**	**0.57**	**0.75**	**0.81**	**0.31**	**1.34**
Much higher or lower scores compare to mean?	**1 below**	**3 below**	**1 below**	**3 below**	**2 below**	**n/a**	**1 below**	**2 below, 1 above**	**3 below, 2 higher**
Participant number	Participant 89	Participants 26, 89 & 90	Participant 26	Participants 22, 89 & 90	Participants 32 & 90		Participant 90	Participants 22 & 29 (below)	Participants 22, 26 & 90 (below)
Participant number								Participant 31 (above)	Participants 32 & 89 (higher)