

balanced input between all three languages, especially in comparison with the community language, exhibited high levels of active trilingualism. Based on the examination of the amount of input of little Xiaoxiao in relation to her productive skills in her three languages (Mandarin, English, and Japanese), Quay (2008) argued that 20% of language exposure can be sufficient for an actively trilingual child. A recently published study of Arnaus Gil et al. (2021), which included data from 53 bilingual, 64 trilingual and 9 multilingual (4 or more L1s) children, also found the minimum amount of input quantity to be around 20%, independent of the number of L1s involved.

2. Absence of the community language at home

Chevalier found that in studies where parents used the One Parent One Language (OPOL) strategy, the children exhibited either high levels of active trilingualism or at least some active trilingualism. In contrast, in the three reviewed studies where the parents clearly did not follow the OPOL strategy, the children had a diminished ability to use their parental languages. While the consistency in following the OPOL strategy seems to be an important factor in active trilingualism, Chevalier (2015) concluded that the reduction of space for the community language rather than following of the OPOL strategy per se is significant. In cases where families did not follow the OPOL strategy in favour of the community language, the children failed to become actively trilingual. However, in studies in which the parents did not follow the OPOL strategy in order to promote a minority language, active levels of trilingualism were fostered. Similar to Chevalier's (2015) findings, Cantone (2019), De Nijs (2021) and Arnaus Gil et al. (2021) found the parental language strategy (e.g. OPOL) to be less important than the absence of the community language at home.

3. Positive language constellations

Parental discourse style, defined as the use of insisting strategies to motivate a child to actively use each of the three languages, was found to be a salient element in active trilingualism (Chevalier, 2015). In all the studies, in which the parents used insisting strategies for the minority languages, the children were found to use the parental languages when communicating with their parents most of the time. On the contrary, in cases when the parents used the OPOL strategy and avoided speaking the community language to each other but did not use insisting strategies, the children either had lower levels of active trilingualism or were mainly passive trilinguals. In addition to using insisting strategies to encourage children to speak a minority language, Chevalier (2015) and Arnaus Gil et al. (2021) recommend the use of repetition, supply of vocabulary, requests for translation, and child-centered interactions.

7. Parent as a linguist-investigator

Chevalier defined a linguist-investigator as a person who manipulates the quantity as well as quality of input in all three languages. While the evidence from the reviewed studies made it difficult to judge the importance of this variable, Chevalier (2015, p.85) concluded that, in studies where at least one of the parents served as a linguist-investigator, strong “impact belief” was observed. These parents manipulated the quantity as well as quality of input in their children’s minority languages, which led to active levels of trilingualism.

8. Status of the languages

Chevalier (2015) found that the perceived prestige of the languages involved is influential in their fostering. Societal status of minority languages depends on each society and country. Languages with a high status or prestige are more likely to be retained and imparted to children than languages with a low status. Based on their analysis of data from 70 trilingual families in England and Germany, Braun & Cline (2014) also concluded that

language status plays a significant role in promoting active levels of trilingualism. They found that, in 89% of the English families, two languages got lost, whereas in 83% of the German families, all three languages were maintained, including English as an additional language. Braun & Cline (2014) argued that the low status of some languages, such as Russian or Urdu, was likely responsible for these percentages.

In her own longitudinal study, Chevalier (2015) followed two young trilingual children, Lina and Elliot, between the ages of 2;01 and 3;01. Both children were born and raised in different parts of Switzerland. Lina was exposed to Swiss German from her mother, French from her father, and English from her American aunt who frequently visited Lina. In addition, Lina's parents communicated in English, so she had indirect exposure to English as well. Elliot was exposed to English from his mother, Swiss German from his father and French from daycare. The data was collected in the form of interviews with parents, video recordings of the playtime activities of each child using each of the three different languages as well as observational visits to the two families. In her robust study, Chevalier (2015) performed a triangulation of the three methods, which helped with the validation of her findings.

The data analysis revealed that while Elliot was an active trilingual between the ages of 2;01 and 3;01, Lina was only a receptive trilingual. Chevalier attributed Elliot's active trilingualism to contextual factors such as relatively balanced input in all three languages, absence of the community language at home, variety of contacts in his minority (parental) languages, and encouraging parental discourse style. On the other hand, Lina was found to be a receptive trilingual due to her high amount of input in Swiss German compared to the other two languages, presence of the community language at home, lack of contact variety in French and English, as well as her father's relaxed parental discourse style.

While the study focused on the examination of the children's trilingualism during the third year of their lives, Chevalier (2015) continued to follow the two families for a few more years. Based on additional video recordings conducted between the ages of 3;01 and 4;00, and follow-up interviews with the two families when the children started school, Chevalier (2015) discovered that, by the age of 4;00, Lina's productive competence in French had become stronger although she could speak it only to a very limited extent. In terms of her English skills, she continued to speak to her aunt in a mixture of English and Swiss German. On the other hand, Elliot continued to be actively trilingual at least until the age of 7 when his strongest language was English (language of his mother + language of the community in his international school), followed by Swiss German and French.

Based on her thorough review of 15 trilingual studies as well as on her own study of two trilingual children, Chevalier (2015) concluded that active levels of trilingualism in early childhood are possible although not automatic. Chevalier's longitudinal study demonstrates that early multilingual language acquisition is dynamic and changes in language dominance are not rare even at an early age. This finding suggests that, if a child growing up with three languages is not productive in all three languages early on, it does not mean that he or she will never become actively trilingual. With quantitative and qualitative changes in input outlined earlier in this section, children have the potential to achieve productive mastery of all three languages.

2.4 Review of studies on early quadrilingual language acquisition

While research on early bilingualism has enjoyed popularity for many years and studies on trilingual language acquisition in young children have started to soar as well, investigations into early quadrilingualism are still scarce. There are several possible reasons for this. Firstly, the number of children raised quadrilingually is significantly lower than the

number of families in which children are exposed to two or three languages. As a result, there may be less interest or perceived need of funding for this type of study. Also, researchers are likely to come across difficulties with the recruitment of participants from a relatively small pool of potential subjects. Secondly, research on quadrilingual language acquisition is far more complex than research with bilingual or trilingual participants. In studies on simultaneous bilingualism, for example, two languages and the use of two possible combinations is examined. The use of three languages gets more complicated, with more possible ways to mix and switch between them. With four languages acquired simultaneously, the data collection becomes even more complex and time-consuming.

Our extensive search for studies on early quadrilingual language acquisition yielded only two relevant case studies, which is a clear demonstration of the fact that research on early quadrilingual language acquisition is still in its infancy. On the following pages, we analyze each of the two studies in detail.

2.4.1. Maneva (2004)

The case study of Blagovesta Maneva (2004) was, to our knowledge, the first published study on early quadrilingual language acquisition. In her longitudinal observations of her daughter, Daria, from birth to the age of five, Maneva (2004) focused on similarities and differences in the simultaneous acquisition of two minority languages at home (Bulgarian – mother’s language and Lebanese Arabic – father’s language) and two official languages of the community outside of the home in Canada (English and French). The researcher/mother regularly collected data in the form of audio recordings and written direct as well as indirect observations, although no further information regarding the used methods or data collection were included in the published article.

According to the family language history, Daria was mostly exposed to Bulgarian and Lebanese Arabic during the first year of her life. Her parents used the OPOL strategy consistently during that time. Daria's contact with French and English was "random and passive" until the age of 1;10 (Maneva, 2004, p. 111). She was mostly exposed to French in parks, when taken care of by friends, during family visits or when she had screen time. Her exposure to English came from visits to parks, visits of English-speaking family friends and passive TV watching. At the age of 1;10, Daria started attending a French-speaking daycare, which quickly resulted in French becoming her language of preference. Maneva (2004) described her daughter as a relatively balanced trilingual (Arabic, Bulgarian and French) between the ages of 1;10 and 3;4. In addition to speaking three languages with similar proficiency, Daria started showing interest in using English around the age of 3;0. Until then, she had only had passive exposure to the language. At the age of 3;4, Daria started using increasingly more French when speaking to her father and, around the same time, French became Daria's dominant language. Between the ages of 3;11 and 4;6, Daria attended a bilingual French-English preschool, which led to Daria's improvement in English. By the age of 5;0, French was the dominant language of communication between Daria and her father. Daria's exposure to Arabic had become increasingly passive, and she sometimes appeared not to understand her father. However, when speaking on the phone with non-French speaking relatives, she "demonstrated a superior competence in Arabic" according to Maneva (2004, p. 115). At the age of 5;0, Daria's dominant language was French, followed by Bulgarian, English and Arabic. The study suggests that Daria fully understood French, Bulgarian and English. Her understanding of Arabic was not perfect, but she seemed to comprehend most of what her father said to her. In terms of her productive skills, Daria could speak all four languages with varying levels of proficiency.

The study presents valuable findings regarding the importance of peer exposure. Maneva (2004) distinguished between active exposure (child as an active participant in a linguistic exchange) and passive exposure (child as a listener). In addition, she considered two types of active exposure, one between the child and adults, and the other between the child and peers. Maneva (2004) found that Daria's active exposure to peers speaking one of Daria's non-dominant languages led to marked improvements in the language in which the exposure had occurred. She reported noticeable effects of such exposure on Daria's acquisition of vocabulary, grammar, syntax as well as semantics. Based on these observations, Maneva (2004) concluded that active exposure, especially active interaction with peers, significantly contributes to language acquisition. She also argued that the effects of passive exposure are negligible unless reinforced by active exposure. This was evident when evaluating Daria's English language acquisition, which improved significantly once Daria started actively using the language in preschool.

In addition to active peer exposure, Maneva (2004) identified the use of the OPOL strategy as an important factor in promoting child multilingualism. She also highlighted the necessity of a balanced input in all four languages. Finally, Maneva (2004) found positive attitudes of the child's family and community towards multilingual acquisition to affect the child's own perception of multilingualism.

While Maneva's (2004) study provides a significant amount of anecdotal information about Daria's quadrilingual development, the research article itself does not include any details about data collection or analysis, which makes it difficult to evaluate the quality of the methodology used. The research article makes us question the calculation of Daria's language input. Maneva (2004) wrote that for about a year and a half after starting daycare, Daria had relatively balanced input in Arabic, Bulgarian as well as French and was a relatively balanced trilingual during this period. Unfortunately, there is no information about the number of hours

Daria spent at daycare on a weekly basis, which makes us wonder whether she went for half days or full days. If she attended her daycare full-time, it is unlikely that her input in all three languages was relatively balanced. Also, the fact that Daria's father spoke Bulgarian with native-like proficiency and the two parents communicated in Bulgarian makes us question the equality of Daria's input in all three languages. Despite significant limitations, Maneva's (2004) study deserves to be acknowledged for shedding light on the nature of early quadrilingual language acquisition and for informing the present research project.

2.4.2. Hakansson & Waters (2021)

In their case study of a seven-year-old quadrilingual boy, Stefan, simultaneously exposed to four languages (English, French, Russian and Swedish) before his first birthday, Hakansson & Waters (2021) examined the influence of exposure and cognates when acquiring four languages simultaneously. Stefan was addressed in Russian by his mother, in French by his father, and in Swedish at daycare and in his community. The parents communicated in English, but they never addressed Stefan in English. Based on estimates made by his parents, Stefan had the largest exposure to Russian (approx. 44% of total exposure) and Swedish (approx. 44% of total exposure), followed by French (approx. 12% of total exposure) during the first six years of his life. He was exposed to English only indirectly when the parents talked to each other, and this indirect exposure to English was, therefore, not included in the parents' estimates.

Hakansson & Waters (2021) chose a quantitative approach to examine Stefan's language comprehension and production in all four languages, which is a unique approach in multilingual research. The recently-developed Cross-Linguistic Lexical Tasks (CLT) test allowed them to measure Stefan's noun comprehension, verb comprehension, noun production and verb production by using simple pictures (Haman et al., 2015). The advantage

of this test is that it can be adapted to various languages, which makes different test results comparable.

Based on the outcomes of the CLT tests conducted in each of Stefan's four languages, the boy comprehended 91% of all the words included on the tests and successfully used 60% of the words in production section of the tests. His scores on comprehension and production showed various degrees of proficiency in all four languages, with comprehension exceeding production in each language. His comprehension scores in his four languages were: 81% for English, 89% for French, 94% for Swedish, and 100% for Russian. As for production, Stefan's scores were: 30% for English, 53% for French, 69% for Russian, and 73% for Swedish. Through their data analysis, Hakansson & Waters (2021) concluded that Stefan's language exposure had an effect on his language proficiency, which is in line with previous research in the field of bilingual and trilingual language acquisition. In addition, they identified the difference between direct and indirect exposure as a possible explanation for the disparity in proficiency. According to the results, direct exposure to a language will likely lead to higher proficiency than indirect exposure. Hakansson & Waters (2021) concluded that children growing up quadrilingually have the potential for good comprehension in all four languages and that a multilingual childhood is possible.

Hakansson & Water's (2021) quantitative case study is the first one of its kind, examining vocabulary in a quadrilingual child. The published article shows signs of quality research by clearly stating four research questions, and providing detailed information about the methodology, data analysis as well as test results. However, more clarity regarding how Stefan's parents calculated the percentages of his language exposure would be useful. Even though Stefan was four years older than the girl participating in the present research project, the case study of Hakansson & Waters (2021) is considered relevant and informative for our inquiry.

2.5 Summary of findings from the reviewed literature

Based on the reviewed literature, it is apparent that different terms are used inconsistently, so conclusions from studies on multilingual language acquisition need to be interpreted with caution. Findings from methodologically robust studies suggest that it is possible for young children who are regularly exposed to three languages to become actively trilingual. However, relatively balanced input in all three languages alone is not sufficient enough to achieve active levels of trilingualism. Scholars have identified seven additional factors that have the potential to affect active trilingualism in early childhood, including positive language constellations, variety of language contact and media, insistent parental discourse style, absence of the community language at home, active manipulation of the quantity as well as quality of input, and the status of the languages involved. With regard to early quadrilingualism, only two studies on simultaneous acquisition of four languages in early childhood have been identified so far, both suggesting promising findings regarding the possibility to achieve quadrilingualism in early childhood. More research with strong methodologies is needed before conclusions can be made regarding the nature of early quadrilingual language acquisition and the ability of young children to be productively quadrilingual.

CHAPTER 3: METHODOLOGY DESIGN

This research project aimed to examine the quadrilingual language acquisition of a three-year-old child who has been regularly exposed to three languages since birth and a fourth language since the age of 1;06. In this section, we first present our rationale for the choice of the used methodology as well as methods of data collection. We also provide a detailed description of the child's background and language history. In addition, we present detailed information about the data collection procedure and data analysis. Finally, this section includes ethical considerations to which the researcher adhered throughout the case study.

3.1 Methodology

As is the case with the majority of research on early multilingual language acquisition, the present inquiry relies on the method of a longitudinal case study. Case studies are investigations of a single participant or a small group of participants, focusing on depth rather than breadth in their scope and analysis (Hua & David, 2008). According to Duff (2011, p.98), "by studying small numbers of research subjects, complex and dynamic interactions between the individual and the local social, cultural and linguistic environment can be observed." While the findings from a case study cannot be widely generalized, it is considered to be a powerful form of inquiry due to its potential to yield insights of wider relevance and theoretical significance. Bassey (1981) argues that, rather than generalizability, reliability should be an essential criterion for judging the merit of a case study.

A longitudinal approach was chosen for the present case study because we were interested in tracing changes in a child's quadrilingual language acquisition over time. The advantages of longitudinal studies include the ability to capture the development of patterns

and changes, the possibility to examine individual differences as well as access to more comprehensive and representative data (Hua & David, 2008).

3.2 Participant and her language history

The participant in this single case study, Sofia, was the daughter of the researcher conducting the present inquiry. Her first name was changed in this dissertation in order to protect her privacy. The researcher is well aware of the ethical concerns related to the enrollment of a family member in research. To ensure that the recruitment and consent process were free from undue influences, Sofia's father was asked to decide about his daughter's participation in the study. Considering the fact that the research presented minimal risks to the child participant, Sofia's father agreed to provide informed consent.

Sofia had regular input in three languages since birth and a fourth language since the age of 18 months. She was born in the Italian-speaking part of Switzerland to a Slovak mother who spoke to her in Slovak and a Japanese father who spoke to her in Japanese. Both parents agreed to use the one-parent-one-language (OPOL) strategy when Sofia was born. While Sofia's mother was very consistent in using only Slovak when communicating with her daughter, Sofia's father was less and less consistent as she was getting older. Sofia also had an older sibling who communicated with her in a mix of languages, mostly Slovak and a little bit of English. In addition to a small, *direct* input in English from her brother, Sofia had *indirect* input in English since it was the language of communication between her parents. Although Sofia was raised in the Italian-speaking canton of Switzerland, she was not regularly exposed to the Italian language until the age of 18 months when she started attending an Italian-speaking nursery for approximately 20 hours per week. It is important to note that Sofia's family spent several extended vacations in Slovakia, including 6 weeks each summer, 2 weeks around Christmas and a few other week-long visits, during which she was

completely immersed in Slovak. Mainly due to the COVID pandemic, the family did not have a chance to visit Japan during the first four years of her life.

Sofia spoke predominantly Slovak with her mother until the age of three. Between the ages of 2 and 3, she occasionally borrowed single words or phrases from Italian, but this did not happen frequently. In addition to speaking Slovak when interacting with her mother, Sofia also consistently used the language to communicate with her older brother, her grandparents, cousins and her Slovak-speaking friend. Until the age of 2;06, she also used Slovak for self-talk.

In terms of Japanese, Sofia demonstrated full understanding of the language, but she did not always respond to her father in Japanese. Since he understood both Slovak and Italian quite well, he did not insist that Sofia responded to him in Japanese. As time passed, Sofia used less and less Japanese when communicating with her father. Unfortunately, Sofia did not have a variety of Japanese-speaking contacts. Her father served as the only source of regular input Sofia had in Japanese.

English was another language to which Sofia was exposed from birth, although her direct input in this language was very limited until the age of 3;04. While Sofia did not actively speak English frequently until she started pre-school, her behavior clearly showed that she fully comprehended the language. English-speaking friends of the family always felt that she understood everything they were telling her, even though she hardly ever responded to them in English. Also, when her parents communicated in English at the dinner table, Sofia often reacted to what they were saying in either Slovak or Japanese, which demonstrated her comprehension of the language. From the age of 1;06, Sofia had 3 hours of English classes per week at daycare. According to her teachers, Sofia actively contributed in English during each class.

With respect to Italian, Sofia started having regular input to this language when she started attending daycare at the age of 1;06. Based on the feedback from her carers, Sofia was able to acquire the language within a few months. By the age of 2;00, she not only comprehended Italian, but was able to use it without any difficulties with her teachers and the other children at daycare. Around the age of 2;06, Sofia started using Italian for self-talk.

At the age of 3;04, Sofia finished attending her Italian-speaking daycare and joined an English-speaking pre-school, which led to significant changes in her language input as well as in her language proficiency examined in this research project.

3.3 Instruments

The vast majority of studies on multilingual language acquisition include a method or a combination of methods to determine language input and proficiency. In the present study, we have chosen to use language diaries kept by the parents of the child participant to examine Sofia's language input and video recordings of role play activities of the child participant with four interlocutors to study her language proficiency in each language. Both types of methods were used to collect data when Sofia was 3;0 and 3;11. The rationale for the use of each instrument is explained below.

Language diary

Hoff & Rumiche (2011) and De Houwer (2011) recommend using language diaries to get a more direct measure of children's language experience. Originally developed by De Houwer & Bornstein (2003) for their study of Dutch-French bilingual children, this method has been found to provide reliable data on the nature of an individual's bilingual experience. Although language diaries have not been used with trilingual or quadrilingual participants

yet, we decided to use them in the present research project as they could provide a basis for validating the amount of Sofia's exposure to each language.

Video recording

Video recording is also considered to be a rich source of information, especially in research with children, because it allows for repeated viewings and a richer picture of interactions between the studied participants. Video recording was chosen over audio recording in the present study in order to capture body language and other aspects (e.g. eye gazing, nodding, head shaking) that would have otherwise gone unnoticed.

In addition to the methods outlined above, we considered using the cross-linguistic lexical task (CLT) instrument (utilized by Hakansson & Waters, 2021) as a measure of Sofia's language proficiency in each language. The test has over 30 different language versions and is suitable for children between the ages of 3 and 7 years. Each language version was developed based on the same procedure and criteria, which would allow for cross-linguistic comparisons. However, the Japanese version of the CLT has not been developed yet, so we were, unfortunately, not able to use this instrument.

3.4 Data collection procedure and data analysis

3.4.1 Language diaries

The researcher completed a 7-day language diary when Sofia was 3;01 and again when she was 3;11. The diary consisted of 7 pages with rows for each 30-minute period from 6am to 10pm. Each diary page also included space to add more waking hours and columns to indicate the language(s) to which the child was exposed during the time period, the people

who interacted with her (e.g. mother, sibling), and the context of the interactions (e.g. book reading, lunch). For a sample page from the language diary, please see Appendix A.

The data from the language diaries was analyzed quantitatively by counting the number of hours Sofia was exposed to each of the four languages. In cases when the family was together and both languages were used to communicate with Sofia, half of the exposure was added to Slovak input and the other half to Japanese input. In addition to examining the number of hours of Sofia's exposure to each of the four languages, we counted the number of conversational partners she had with speakers of each language as well as the context of the interactions. While the analysis of the variety of language contacts was included in the present research project, the context of the interactions was beyond the allowed length of this dissertation and was, therefore, excluded.

3.4.2 Video recordings

In order to examine Sofia's relative language proficiency, four video recordings with four different interlocutors were made when Sofia was 3;01 and again when she was 3;11. One recording was conducted with a Slovak interlocutor (mother/researcher), one with a Japanese interlocutor (father), one with an English interlocutor (adult friend), and one with an Italian interlocutor (adult friend). All of the interlocutors were provided with a detailed list of instructions on how to record the video and what kind of play activities to perform with Sofia.

Each session was recorded in Sofia's home environment. The recordings were between 10 and 20 minutes long. They were transcribed and stored securely on an encrypted external hard drive. It took approximately 3 hours to complete a 15-minute transcription. The researcher transcribed all the speech that was heard on the recordings. Sounds and body language were also transcribed when they were considered relevant to the conversation (e.g.

nodding, head shaking). Upon finishing all the transcriptions, the researcher double-checked them with Sofia's father to enhance the reliability of the data.

The analysis of the data commenced by examining Sofia's comprehension of each language. Her receptive skills were assessed by analyzing how she reacted to the speech of the individual language interlocutors. We evaluated the appropriateness of her responses and the use of translation equivalents. Sofia's language production in each language was analyzed based on the relative quantity of single-language/mixed utterances, mean length of utterance (MLU) and upper bound.

MLU is a commonly used measure of language development in bilingual and multilingual children. The calculation of the mean length of utterance in words (MLU_w) as opposed to the mean length of utterance in morphemes (MLU_m) was chosen to analyze the collected data because some languages are morphologically more complex than others, which could lead to skewed results. In their comparative study between MLU_w and MLU_m, Parker & Brorson (2005, p. 373) found MLU_w to be a more effective measure of language development than MLU_m because "it can be used more readily and reliably across various languages." However, Lanza (2004) cautions against comparing MLU_w scores across different studies and different cases, arguing that only comparisons of MLU_w results from a single child across different dimensions can be made reliably. In the present research project, we compared Sofia's MLU_w scores between her four languages and between the two times of data collection.

The MLU(w), defined as the average length of a participant's utterance in a given transcript, has been found to be a reliable measure of language development (Ezeizabarreba & Garcia Fernandez, 2018; Lanza, 2004; Parker & Brorson, 2005). It is calculated by dividing the total number of an individual's words by the total number of his/her utterances in a transcript. Brown (1973) recommends using 100 utterances for the calculation of MLU_w.

Our definition of an utterance is consistent with that of Chevalier (2015) and Lanza (2008) who defined it as a segment of speech with a terminal intonation contour marked by a period, question mark or an exclamation mark. When defining the term word, we, again, borrowed Chevalier's (2015) definition, according to which a word is any sequence that is semantically interpretable and delimited by blank spaces or punctuation marks. We used the following criteria to count words and utterances:

- utterances consecutively repeated the same way were only counted once,
- words consecutively repeated more than once within an utterance were only counted once,
- songs, poems and counting of numbers were counted as one word,
- utterances were counted even when they included morphosyntactic mistakes as such mistakes are common at the ages under the study,
- discourse markers (oh, aha, etc.) were not counted.

In addition to calculating the MLUw, we were interested in counting the upper bound (the longest utterance) in each of Sofia's languages at the age of 3;01 and again at the age of 3;11. According to Parker & Brorson (2005), upper bound scores reflect the tendencies that are visible in the MLUw counts. Together, they provide a reliable measure of one's language proficiency. We included only spontaneous non-mixed utterances in our calculation of the upper bound in each language, which is consistent with Chevalier's (2015) approach to calculating upper bound in her study of active trilingualism in early childhood.

3.5 Reliability and validity

Reliability and validity are issues that need to be approached through attention to a study's conceptualization and the way in which the data is collected, analyzed and

interpreted. Reliability refers to the absence of random error. In other words, it assesses the extent to which other researchers would reach similar results and conclusions if they conducted the study again. According to Gibbert et al. (2008), reliable case studies are transparent and replicable. To enhance the transparency of the present case study, we carefully documented and clarified the data collection procedures as well as the data analysis so that they can be replicated by other researchers. We carefully transcribed the video-recorded data and each transcript has been double-checked by the researcher as well as the father of the participant.

Validity in case study research is a concept reflecting if the results of a study are trustworthy and meaningful. *Internal* validity refers to how well a case study is conducted in terms of its structure, and *external* validity refers to how applicable the findings are in the real world. Another important aspect of quality research is *construct* validity which refers to the extent to which a study examines what it claims to examine (Denzin & Lincoln, 1994). Gibbert & Ruigrok (2010) suggest the following three strategies to ensure construct validity: triangulation of research methods and/or data sources, establishment of a clear chain of evidence so that the reader can understand how the researcher reached the final conclusions from the initial research questions, and peer review of transcripts and drafts of the evolving case study. In order to increase the construct validity in the present case study, we chose not to focus merely on the researcher's observations of the participant's quadrilingual language acquisition, but we incorporated additional instruments to collect more objective data about the participant's language input as well as language proficiency in each language. To measure language proficiency in each language, we calculated the MLUw and upper bound, which have been shown to reflect similar tendencies regarding language proficiency. In addition, we had the draft of the case study reviewed by a fellow researcher who confirmed that the findings are consistent.

3.6 Ethical considerations

The present study was conducted in accordance with the UWTSD Research Ethics and Integrity Code of Practice, the UWTSD Research Data Management Policy and the British Educational Research Association (BERA) Ethical Guidelines for Educational Research (2018). Due to the researcher's close relationship with the participant, her father was asked to consider providing consent for his daughter's involvement in the present case study. He was assured that his daughter had the right to withdraw from the study at any stage. It was our priority to keep the participant's identity confidential and, therefore, her name was changed in all computer and word processing records. We also made sure that she was in no way harmed as a consequence of her participation in the present research project. We are glad to report that she showed no signs of distress from the outset of the project through to its completion. Due to the participant's young age, the father requested that the video recordings can only be viewed by the researcher, which will be adhered to.

CHAPTER 4: DATA ANALYSIS

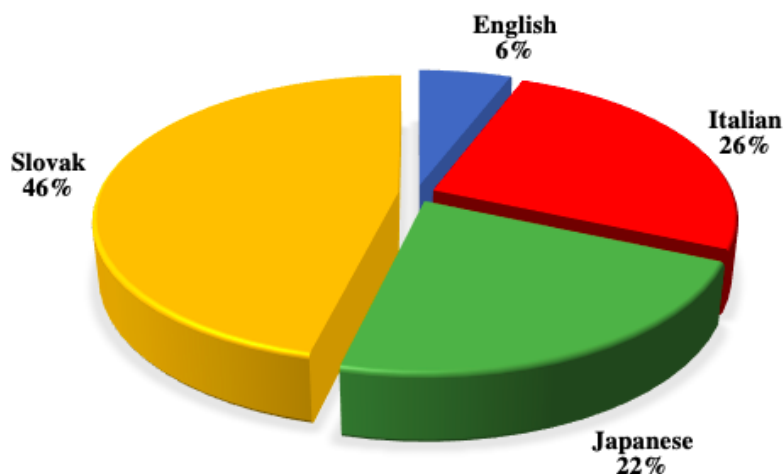
In this section, we present the results of the quantitative analysis of Sofia's language diaries, and quantitative as well as qualitative analysis of video recordings of Sofia with four different interlocutors when she was 3;01 and 3;11.

4.1 Quantitative analysis of Sofia's language diaries

4.1.1 Sofia's language diary at the age of 3;01

Sofia's first language diary included data representing 85.5 hours of Sofia's direct input in her four languages during her usual week. Based on the collected data, Sofia had a total of 39.5 hours (46%) of input in Slovak, 22 hours (26%) of input in Italian, 19 hours (22%) of input in Japanese and 5 hours (6%) of input in English.

Figure 4.1: Sofia's weekly language input at the age of 3;0



It is important to note that, in addition to having 5 hours of direct input in English, Sofia also had at least 10-15 hours of indirect input in English every week. She regularly heard the language when her parents were talking to each other and when their family friends were visiting.

The analysis of the numbers of people who regularly interacted with Sofia in each language at the age of 3;01 revealed that she had the largest number of Italian contacts (8 peers + 4 adults), followed by Slovak (4 peers + 4 adults), English (3 adults) and Japanese (1 adult) contacts.

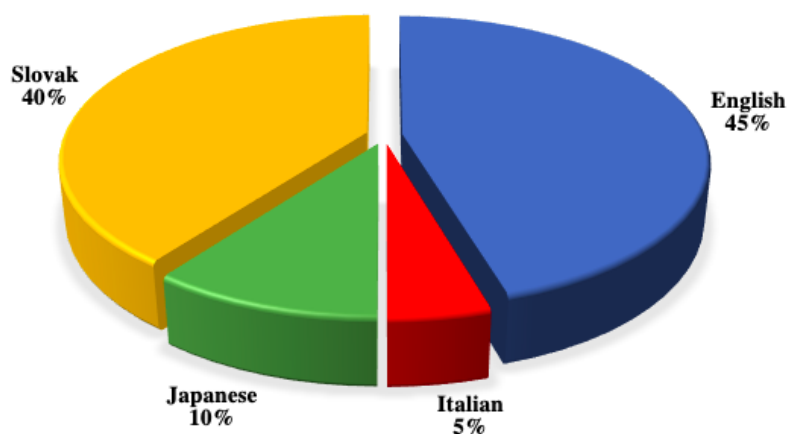
Table 4.1: Variety of Sofia’s contacts at the age of 3;01

	Adult contacts	Peer contacts	Total contacts
English	3	0	3
Italian	4	8+	12+
Japanese	1	0	1
Slovak	4	4	8

4.1.2 Sofia’s language diary at the age of 3;11

Sofia’s second language diary included data representing 88 hours of Sofia’s exposure to her four languages during a usual week. Based on the collected data, Sofia had a total of 40 hours (45%) of input in English, 35 hours (40%) of input in Slovak, 9 hours (10%) of input in Japanese (often mixed with English), and 4 hours (5%) of input in Italian.

Figure 4.2: Sofia’s weekly language input at the age of 3;11



The analysis of Sofia’s contact variety with speakers of each language showed that she had the largest number of English contacts (16 peers + 6 adults), followed by Slovak (4 peers + 4 adults), Italian (4 peers + 1 adult) and Japanese (1 adult) contacts.

Table 4.2: Variety of Sofia’s contacts at the age of 3;11

	Adult contacts	Peer contacts	Total contacts
English	6	16+	22+
Italian	1	4	5
Japanese	1	0	1
Slovak	4	4	8

4.2 Quantitative and qualitative analysis of video recordings

4.2.1 Analysis of Sofia’s interactions with an English interlocutor

English comprehension

The analysis of the first video recording of Sofia with an English-speaking adult showed that the girl comprehended all of her friend’s utterances at the age of 3;01. Her verbal responses as well as her body language (nodding, head shaking, etc.) indicated that she understood the conversation and was able to reply appropriately in all instances. For example, when pretending to be a chef, she used toy food to make a pizza based on her friend’s wishes, which served as evidence that Sofia understood what her friend was saying to her. No confusion or inadequate responses were detected throughout the video recording, which showed Sofia’s high level of comprehension in English at the age of 3;01.

Sofia’s comprehension of the English language continued to be very strong at the age of 3;11. At no point during the recording did she express any confusion or hesitation about what was being said to her. The fact that she responded to every utterance appropriately indicated that Sofia fully understood everything in English during the recording.

English production

The first video recording with an English speaker revealed that Sofia had quite limited productive ability in English at the age of 3;01. Her MLUw was 1.55 and her upper bound was 3. Despite Sofia's relatively limited ability to express herself in English, she used non-mixed English utterances 82% of the time. A total of 12% of her utterances were either in Slovak or a mix of English and Slovak. The remaining 8% of her utterances were in Italian or a mix of English and Italian.

Table 4.3: Sofia's MLUw, Upper bound and percentage of non-mixed utterances in English at the age of 3;01

	Age of 3;01
MLUw	1.55
Upper Bound	3
Example of Upper Bound	What you want?
% of non-mixed utterances in English	82%

During the first recording, Sofia used a total of 31 single-word English utterances, 9 two-word English utterances and six three-word English utterances. Example 4.1. presents an excerpt, which shows that the majority of Sofia's English utterances at the age of 3;01 were single words.

Example 4.1

Situation: Sofia is pretending to be a baby who has just woken up.

- Friend: You are awake now. What would you like to do?
Sofia: **Pizza**
Friend: You want to eat pizza? Are you hungry again?
Sofia: **(nods)**
Friend: You are such a hungry little baby! And what would you like to drink?
Sofia: **Juice.**
Friend: Orange juice or tomato juice?
Sofia: **Orange.**

Friend: Orange juice is sweeter, isn't it?
 Sofia: **(nods)**
 Friend: Here you are, orange juice.
 Sofia: **(pretends to drink) Yum.**
 Friend: Was it good? You liked it?
 Sofia: **(nods) Pizza. (handing her friend a slice of pizza)**
 Friend: Pizza? For me?
 Sofia: **(nods)**
 Friend: Thank you!
 Sofia: **For me too.**

The second recording with an English-speaking interlocutor showed that Sofia's ability to produce English had increased tremendously since the first recording. At the age of 3;11, her MLUw was 4.68 and her upper bound was 16. In addition, 100% of Sofia's utterances during the second recording were in English.

Table 4.4: Sofia's MLUw, Upper bound and percentage of non-mixed utterances in English at the age of 3;11

Age of 3;11	
MLUw	4.68
Upper Bound	16
Example of Upper Bound	So you are going to put the presents in and I am going to wrap them.
% of non-mixed utterances in English	100%

Sofia's second recording includes a total of 87 utterances, of which 13 contain 9 or more words. The short extract from Sofia's conversation with an English speaker in Example 4.2 shows how well the girl could express her thoughts in English at the age of 3;11.

Example 4.2

Situation: Sofia and her friend are pretending to go to a party.

Sofia: **I am ready. Let's go! Here it is!**
 Friend: Great! Time to dance!

Sofia: **No, it's not. It's time to eat cake.**
 Friend: I like cake. Is it a chocolate cake or a vanilla cake?
 Sofia: **It's a strawberry cake. My favorite!**
 Friend: Can I have two pieces of cake?
 Sofia: **Only one. Everybody is having one.**
 Friend: Ok.
 Sofia: **Also, if you want to swing, so you have to ask by yourself. If you are shy, I can come with you.**

In her speech at the age of 3;11, Sofia demonstrated the ability to use simple, compound as well as complex sentences with only minor grammatical mistakes. When comparing Example 4.1 with Example 4.2, one can see marked improvement in Sofia's ability to produce the English language between the ages of 3;01 and 3;11.

4.2.2 Analysis of Sofia's interactions with an Italian interlocutor

Italian comprehension

The analysis of the first video recording of Sofia and her Italian-speaking friend revealed that Sofia comprehended everything that her friend said to her. She had prompt responses, either verbal or non-verbal, to all of her friend's questions and comments. In cases when Sofia did not respond or comment verbally, she usually nodded in agreement or shook her head in disagreement. No confusion or inadequate responses were detected throughout the video recording, which suggests Sofia's high level of comprehension in Italian at the age of 3;01.

Example 4.3

Sofia: **(sta cantando) Bella stella dimmi tu, cosa vedi dalla su.**
Translation: (singing) Tell me, beautiful star, what do you see from above.
 Friend: **Che bella canzone!**
Translation: What a beautiful song!
 Sofia: **(nods)**
 Friend: **Vuoi cantare per me?**
Translate: Do you want to sing for me?
 Sofia: **(nods and starts singing again)**

In Example 4.3, Sofia nods twice, first in agreement with her friend's statement about the beauty of the song that she is singing and later to indicate that she is willing to sing the song for her friend again. After her second nod, she proceeds to sing again, which shows that she comprehended the question her friend had asked.

The second video recording of Sofia and her Italian-speaking friend indicates that Sofia's comprehension of Italian continued to be very strong at the age of 3;11. Again, the vast majority of her verbal as well as non-verbal responses were appropriate. There was only one word in the whole 15-minute video recording that Sofia clearly did not understand – it was the word 'gratis' (for free). All of Sofia's other reactions and responses showed that she continued to have a high level of comprehension in Italian at the age of 3;11.

Italian production

The first video recording with an Italian interlocutor revealed that Sofia's productive skills in Italian were quite strong at the age of 3;01. The vast majority of her utterances (98%) during the recording were produced in Italian. She only used one Slovak utterance and one mixed Italian-English utterance throughout the entire recording. In addition, Sofia's MLUw based on the video recording conducted at the age of 3;01 was 2.65 and her upper bound was 9. The majority of her utterances included less than four words. However, the fact that 10 of her utterances included 5-7 words indicates that she had the ability to construct longer sentences.

Table 4.5: Sofia’s MLUw, Upper bound and percentage of non-mixed utterances in Italian at the age of 3;01

Age of 3;01	
MLUw	2.65
Upper Bound	9
Example of Upper Bound	Mama, voglio dare crema a papa con la mama.
Translation of Upper Bound example	Mom, I want to give cream to papa with mom.
% of non-mixed utterances in Italian	98%

Example 4.5 below is a demonstration of Sofia’s grasp of Italian grammar in addition to her lexical knowledge at the age of 3;01. When Sofia’s friend asked what she would like to do, Sofia correctly responded, not only in terms of context but also with respect to grammar. She properly conjugated the verb *volere* (want) when referring to what she wanted (*voglio*) and again when referring to what her pretend mom did not want (*non vuole*).

Example 4.4

Situation: Sofia and her friend are engaged in pretend play with three stuffed animals.

Friend: **Olafina vuole sapere cosa vuoi fare.**

Translation: *Olafina would like to know what you want to do.*

Sofia: **Voglio dare la crema a papa.**

Translation: *I would like to give the cream to dad.*

Friend: **Perché?**

Translation: *Why?*

Sofia: **Perché mama non vuole la crema.**

Translation: *Because mom does not want the cream.*

The second recording with an Italian speaker showed that Sofia’s ability to produce Italian had decreased significantly since the first recording. Based on the video recording conducted when Sofia was 3;11, her MLUw was only 1.55 and her upper bound also had also decreased to 6. While an upper bound of six is still quite high, the majority of Sofia’s

responses were only 1-2 words long. Her longest utterance, *Io un gelato vaniglia, per favore* (I vanilla ice-cream, please) lacked a verb, probably due to the fact that Sofia could not remember how to express the word ‘want’ in Italian anymore.

Table 4.6: Sofia’s MLUw, Upper bound and percentage of non-mixed utterances in Italian at the age of 3;11

Age of 3;11	
MLUw	1.55
Upper Bound	6
Example of Upper Bound	Io un gelato vaniglia, per favore.
Translation of Upper Bound example	I vanilla ice-cream, please.
% of non-mixed utterances in Italian	73%

In addition to lower MLUw and Upper Bound, Sofia’s percentage of non-mixed utterances in Italian also dropped significantly compared to the first recording. During her second recorded interaction with her Italian speaking friend, 23.5% of Sofia’s utterances were in English, 2.5% in a mix of Italian and English and 1% in a mix of Italian and Slovak. In Example 4.6, one can see that Sofia used English when expressing more complex ideas. Her production in Italian was mostly limited to single words or short phrases.

Example 4.5

Situation: Sofia and her friend pretending to be Elsa and Ana from Frozen.

- Friend: Ciao! Come stai?
Translation: Hi! How are you?
 Sofia: **Bene. Io sono Elsa.**
Translation: Well. I am Elsa.
 Friend: Sei Elsa? Io sono Ana. Ciao sorellina!
Translation: You are Elsa? I am Ana. Hello, sister!
 Sofia: **Party!** (*non-Italian utterance*)
 Friend: Andiamo per una festa?
Translation: Are we going to a party?
 Sofia: **And we have to wear a dress!** (*non-Italian utterance*)
 Friend: Dobbiamo vestirsi?

Translation: We have to wear a dress?
 Sofia: **Si! Come Elsa! Blu.**
Translation: Yes! As Elsa. Blue.
 Friend: Un vestito blu?
Translation: A blue dress?
 Sofia: **(nods)**
 Friend: Hai due vestiti? Un anche per me?
Translation: Do you have two dresses? One for me, too?
 Sofia: **Si.**
Translation: Yes.
 Sofia: **But it's in my house. This way! And also I have shoes. (non-Italian utt.)**

Overall, Sofia continued to be able to have a conversation in Italian at the age of 3;11 although the extent to which she could express herself well had lowered compared to the first recording. Her MLUw, upper bound as well as her percentage of non-mixed utterances in Italian all reflect the decrease in her ability to produce the Italian language. The relatively high percentage of English utterances when communicating with an Italian-speaking friend suggests that English was Sofia's dominant language at the age of 3;11.

4.2.3 Analysis of Sofia's interactions with a Japanese interlocutor

Japanese comprehension

The analysis of the first video recording with Sofia's Japanese-speaking father revealed that she comprehended all of her father's utterances. She showed no confusion or hesitation when communicating with her father. In addition, all of her responses (both verbal and non-verbal) were appropriate, which suggests that Sofia's comprehension of Japanese was at a high level at the age of 3;01.

Sofia's comprehension of Japanese continued to be strong during the second video recording. Again, she showed no verbal or non-verbal signs indicating lack of understanding. Her conversation with her father was fluid, and all of Sofia's responses were appropriate in the given context.

Japanese production

Based on the first recording with her father, Sofia's production in Japanese was quite limited at the age of 3;01. She produced mostly single Japanese words, which were spontaneous in some cases and non-spontaneous in others. Sofia's MLUw was 1.5 and her upper bound was 4. Despite her limited production in Japanese, Sofia used non-mixed Japanese utterances 76.5% of the time. The rest of her utterances were either Slovak or mixed Japanese-Slovak utterances.

Table 4.7: Sofia's MLUw, Upper bound and percentage of non-mixed utterances in Japanese at the age of 3;01

	Age of 3;01
MLUw	1.5
Upper Bound	4
Example of Upper Bound	Papi, kore mo koko.
Translation of Upper Bound example	Dad, this here too.
% of non-mixed utterances in Japanese	76.5%

Example 4.6

Situation: Sofia and her father are playing with bricks and Lego figurines.

Sofia: **Ok, papi? Kore koko. Ok? Kore, kore, kore, kore to kore. Kore ushi?**

Translation: *Ok, dad? This here. Ok? This, this, this, this, this and this. This cow?*

Father: Ushi nano? Muuuuuu tte iuuno.

Translation: *Is it a cow? Does it muuuuuuh?*

Sofia: **Uh huh. Muuu. Kore. Kore densha. Ok? Papi? Kore koko... Kore koko.**

Translation: *Uh huh. Muuuu. This. This train. Ok? Papi? This here.... This here.*

Father: Ne~ takaku natterune sara. Papaga motte ageru.

Translation: *Wow. It's getting high Sara. Papa will hold it for you.*

Sofia: **Arigato, papi.**

Translation: *Thank you, papi.*

The second recording with Sofia's father showed that the girl's Japanese proficiency had decreased compared to when she was 3;01. Although her MLUw was only slightly lower,

her upper bound dropped from 3 to 1. In addition, the majority of the Japanese words Sofia used during the second video recording were non-spontaneous repetitions of what her father had said to her. Only 43% of Sofia’s utterances when communicating with her father during the second recording were produced in Japanese.

Table 4.8: Sofia’s MLUw, Upper bound and percentage of non-mixed utterances in Japanese at the age of 3;11

	Age of 3;11
MLUw	1.46
Upper Bound	1
Example of Upper Bound	Motto.
Translation of Upper Bound example	More.
% of non-mixed utterances in Japanese	43%

The non-spontaneous nature of Sofia’s Japanese utterances at the age of 3;11 is visible in Example 4.7. On four occasions, Sofia first expressed her thoughts in English. When her father translated them into Japanese, she willingly repeated the translation but did not contribute with any spontaneous utterances. The same pattern was apparent throughout the second transcript of Sofia’s conversation with her father.

Example 4.7

Situation: Sofia is practicing her diving skills.

- Sofia:** **Look!**
Translation: *n/a*
- Father: Mite!
Translation: *Look!*
- Sofia:** **Mite!**
Father: Kami nurashita no?
Translation: *Did you wet your hair?*
- Sofia:** **(nods) Did you see that?**
Father: Mita yo. Mita tte.
Translation: *I saw you. Say ‘mite’.*

Sofia: **Mite. Papa.**

Translation: *Look. Dad.*

Father: Nani?

Translation: *What?*

Sofia: **That! Look.**

Translation: *n/a*

Father: Mite.

Translation: *Look.*

Sofia: **Mite.**

Translation: *Look.*

Father: Nani miruno papa?

Translation: *What is dad supposed to look at?*

Sofia: **I'm going to go in the water...**

Father: Nihongo de. Omizu ni haitte...

Translation: *Say it in Japanese. Go in the water.*

Sofia: **Omizu ni haitte...Ummm for five minutes.**

Translation: *Go in the water..... Ummm for five minutes.*

Father: Gofun hairuno? Gofun nagaku nai?

Translation: *You're going in for five minutes? Isn't five minutes long?*

Sofia: **No. I'm sure I can do it.**

Translation: *n/a*

Father: Go byou? Go byou dekiru no? Jya~ yutte. Go byou tte ieru?

Translation: *Five seconds? Can you do five seconds? Ok, say it. Can you say five seconds?*

Sofia: **Go byou.**

Translation: *Five seconds.*

4.2.4 Analysis of Sofia's interactions with a Slovak interlocutor

Slovak comprehension

The analysis of the first video recording with Sofia's Slovak-speaking mother showed that Sofia was able to comprehend all of her mother's utterances. She showed no confusion or hesitation when communicating with her mother. In addition, all of her responses (both verbal and non-verbal) were appropriate, which suggests that Sofia's comprehension of Slovak was at a very high level at the age of 3;01.

The analysis of the second video recording with Sofia's mother indicated that Sofia continued to comprehend all of her mother's utterances 11 months after the first recording. Again, all of her verbal and non-verbal reactions were appropriate, showing that Sofia

understood what her mother was telling her or asking her to do. Sofia continued to fully comprehend the Slovak language at the age of 3;11.

Slovak production

Based on the first recording with Sofia’s Slovak-speaking mother, Sofia was able to produce the Slovak language at a high level. Aside from one mixed Slovak-Italian utterance, Sofia expressed herself exclusively in Slovak. At the age of 3;01, her MLUw was 2.78 and her upper bound was 8.

Table 4.9: Sofia’s MLUw, Upper bound and percentage of non-mixed utterances in Slovak at the ages of 3;01 and 3;11

Age of 3;01	
MLUw	2.78
Upper Bound	8
Example of Upper Bound	Nie, tvoja je maminka a moje je papa.
Translation of Upper Bound example	No, mom is yours and dad is mine.
% of non-mixed utterances in Slovak	99%

Example 4.8 shows that Sofia was able to use a wide variety of vocabulary and construct simple as well as some compound sentences in Slovak.

Example 4.8

- Sofia:** **Ja budem... Olaf ja budem.**
Translation: *I will..... Olaf I will be.*
Mother: Ty sa budeš hrat s Olafom? Môžeme sa spolu hrat s Olafom?
Translation: *Will you play with Olaf? Can we play with Olaf together?*
Sofia: **Ale niečo nájdem.**
Translation: *But I will find something.*
Mother: Niečo nájdeš?
Translation: *You will find something?*
Sofia: **Áno.**
Translation: *Yes.*
Mother: Dobre.
Translation: *Ok.*

Sofia: **Drž toto, aby aby aby mi dalo to. Ty maličkého a ja veľkého.**
Translation: *Hold this, so that that that will give me. You little one and I big one.*
Mother: Dobre, ja budem mat maličkého.
Translation: *Ok, I will have the little one.*
Sofia: **A ja veľkého.**
Translation: *And I the big one.*
Mother: Dobre, Sofia. Môžeme sa spolu hrať?
Translation: *Ok, Sofia. Can we play together?*
Sofia: **Áno.**
Translation: *Yes.*
Mother: Sofia, tu mám malého Olafa a neviem, kde má otecka.
Translation: *Sofia, Here is little Olaf and I don't know when his father is.*
Sofia: **Neviem aj ja kde má otecka.**
Translation: *I don't know too where his father is.*

The second recording with a Slovak interlocutor showed that Sofia's ability to produce Slovak continued to improve after the first recording. Based on the data collected when she was 3;11, Sofia's MLUw was 3.4 and her upper bound was 10. While both of these scores increased compared to the first recording, Sofia's percentage of non-mixed Slovak utterances decreased significantly from 99% at the age of 3;01 to 69% at the age of 3;11.

Table 4.10: Sofia's MLUw, Upper bound and percentage of non-mixed utterances in Slovak at the age of 3;11

Age of 3;11	
MLUw	3.4
Upper Bound	10
Example of Upper Bound	Ze ja som ujo doktor a budes papa este raz.
Translation of Upper Bound example	That I am the doctor a you will be dad one more time.
% of non-mixed utterances in Slovak	69%

Of her 26 non-Slovak utterances, Sofia produced 20 mixed Slovak-English, 4 English, and 2 mixed Slovak-Italian utterances. The relatively high percentage of Sofia's English and mixed Slovak-English utterances when communicating with her mother suggests that English was Sofia's dominant language at the age of 3;11.

Although the percentage of Sofia's non-Slovak utterances was quite high, it is important to point out that the majority of her mixed Slovak-English utterances included only one or two English words (see Example 4.9).

Example 4.9

Sofia's mixed Slovak-English utterances at the age of 3;11:

Sofia: Ale my môžeme urobiť že **music**.

Translation: We can do music.

Sofia: Ja spinkám a vidím **toy** a sa s tým hrám.

Translation: I sleep and I see a toy and I play with it.

Sofia: Ja nepadnem a ja pôjdem **jump** na môj **bed**.

Translation: I won't fall and I will go jump on my bed.

Sofia: Toto je teraz tvôj **daddy** a toto je tvoja mamička.

Translation: This is your daddy now and this is your mom.

Sofia: Ale on bude do ujo doktorovi a mu bolí uši keď niečo je **loud**, dobre?

Translation: But he will go to the doctor and his ears will hurt when something is loud, ok?

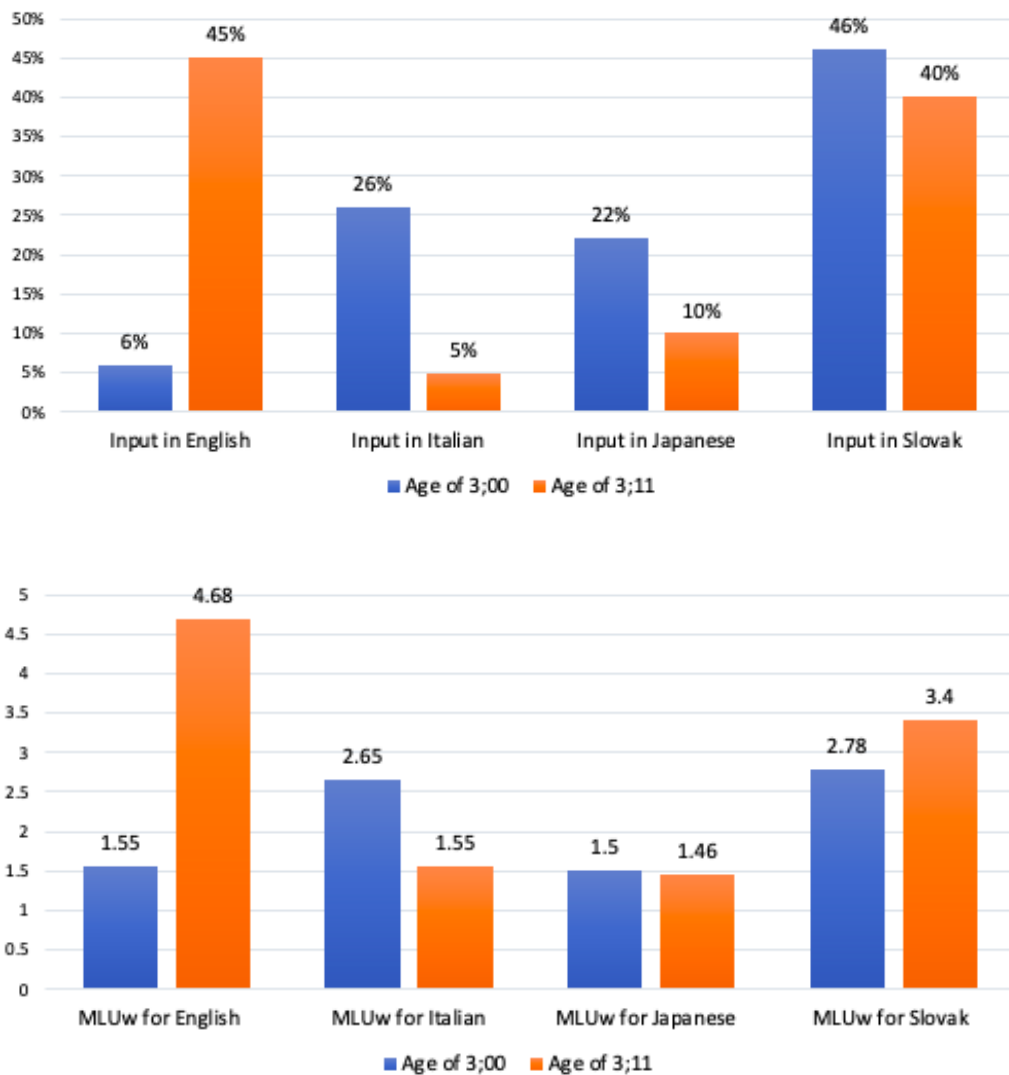
Overall, Sofia's productive skills in Slovak continued to improve between 3;01 and 3;11 although the dominance of English was obvious in many of her utterances. Still, Sofia was able to express her thoughts in Slovak quite clearly. She demonstrated that she could talk to her mother with relative ease.

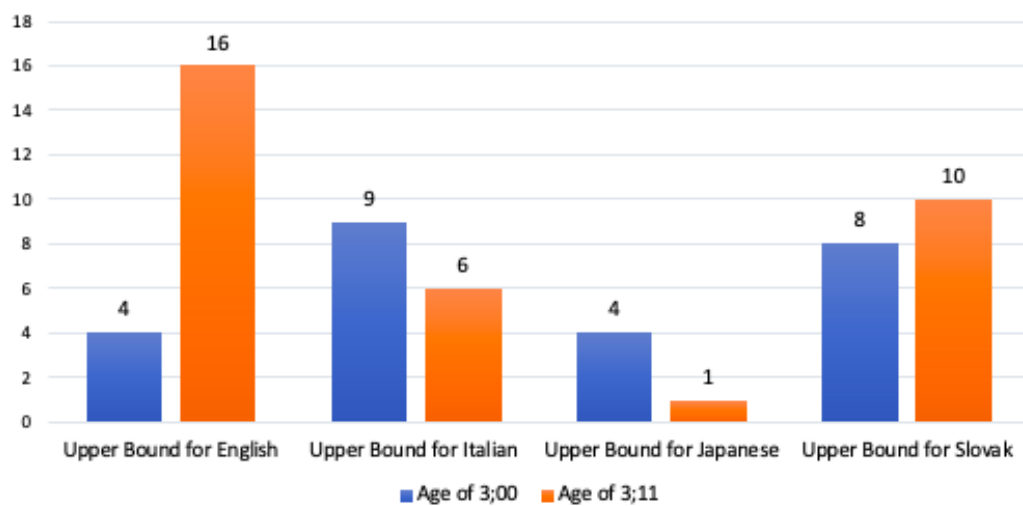
4.3 Relationships between language input, MLUw and upper bound scores

A closer examination of possible relationships between language input, MLUw and upper bound scores indicates the following trends (see Figure 4.3). In three of the four languages, when changes in language input occurred, corresponding changes in MLUw and upper bound scores were also observed. For example, when Sofia's input in English increased from 6% to 48%, her MLUw and upper bound for English rose as well. Her MLUw grew sharply from 1.55 to 4.68 and her upper bound jumped from 3 to 16 between the ages of 3;01 and 3;11. On the other hand, Sofia's sharp decline of Italian input from 26% at the age

of 3;01 to 5% at the age of 3;11 was reflected in significantly lower MLUw and upper bound scores. In addition, Sofia’s Japanese MLUw and upper bound scores also decreased when her input in Japanese declined, although the change in her MLUw score was insignificant. With regard to Slovak, Sofia’s MLUw and upper bound scores increased between 3;01 and 3;11 despite her decreased exposure to the Slovak language (40% at the age of 3;11 as opposed to 46% at the age of 3;01).

Figure 4.3: Visual representation of changes in Sofia’s language input, MLUw and upper bound scores





CHAPTER 5: DISCUSSION OF FINDINGS

In this section, we discuss the findings from the data analysis in relation to the research questions and previous work in the area of early trilingual and quadrilingual language acquisition. Each research question is addressed in a separate subsection.

5.1 RQ1: How well does Sofia comprehend and produce each of the four languages she is regularly exposed to at the age of 3;01?

Based on the analyzed data, Sofia was able to comprehend all four languages at the age of 3;01. She showed no signs of confusion or lack of understanding when communicating in each language context. This finding is consistent with Maneva's (2004) observations of her daughter's comprehension of the four languages to which Daria was regularly exposed at the age of three as well as with Hakansson and Water's (2021) conclusions about the strong comprehension skills of a 7-year-old quadrilingual boy examined in their study.

In terms of Sofia's productive skills, the girl was dominant in Slovak and Italian, followed by English and Japanese when she was 3;01. She had a wider variety of vocabulary in her two dominant languages and expressed herself with ease when using them. When communicating in English and Japanese, Sofia used mostly one- to two-word utterances with a more limited vocabulary. However, she was able to hold simple conversations in both of her weaker languages. We can conclude that, at the age of 3;01, Sofia was a productive quadrilingual with varying levels of proficiency in her four languages.

5.2 RQ2: How does Sofia's production of the four languages change between the ages of 3;01 and 3;11?

Even though Sofia's exposure to her four languages changed significantly between the ages of 3;01 and 3;11, she continued to comprehend all four languages without any

difficulties. However, significant changes were observed in Sofia's productive skills. By the age of 3;11, Sofia's dominant language was English, followed by Slovak, Italian, and then Japanese.

English was the language in which Sofia demonstrated the most significant improvement between the ages of 3;01 and 3;11. During the second data collection, she used a wide range of vocabulary, expressed herself with ease and exhibited no code-mixing. English was the language Sofia started using in pre-school at the age of 3;04. Due to increased amount of input and a greater variety of contacts, especially peer contacts, Sofia's English skills improved very quickly and, by the age of 3;11, it was clearly her dominant language.

In Slovak, Sofia was able to use a variety of vocabulary and sentence structures. However, almost a third of her utterances in the video recording conducted with her mother at the age of 3;11 included a mix of Slovak-English utterances. This could be due to the high amount of input in English, high number of English-speaking contacts, especially peers, or Sofia's knowledge of the fact that her mother could understand English. Despite a slight decrease in input in Slovak between 3;01 and 3;11, Sofia's proficiency in Slovak continued to improve, as demonstrated by her greater MLUw and upper bound scores.

Sofia's Italian production suffered the most between 3;01 and 3;11 due to significant changes in the amount of input and contact variety with Italian speakers from the age of 3;04 onwards. Between the ages of 3;01 and 3;11, Sofia went from speaking Italian fluently to using mostly one- to two-word utterances. Interestingly, she demonstrated fewer mixed utterances in Italian than in Slovak even though her productive skills in Slovak were significantly stronger.

Finally, Sofia's Japanese productive skills experienced a slight decrease between 3;01 and 3;11. In the second video recording with her Japanese-speaking father, the majority of

Sofia's utterances were not spontaneous and she expressed herself in Japanese only 43% of the time, responding to her father predominantly in English. The decline in Sofia's productive skills in Japanese was likely related to the reduced amount of input and the low number of Japanese-speaking contacts (no peer contacts) she had at the time. Based on previous research, other factors that could have affected Sofia's limited productive skills in Japanese were her father's lack of consistency in following the OPOL strategy and his relaxed parental discourse strategy (Chevalier, 2015; Maneva, 2004).

5.3 RQ3: How do changes in language input affect Sofia's comprehension and production of the four languages?

Language input certainly played a role in Sofia's multilingual language production, which is consistent with previous research in this field (Chevalier, 2015; Hakansson & Waters, 2021; Maneva, 2004). The data from the present study revealed that in the case of three of the four languages, when the amount of Sofia's language input changed, her language proficiency was affected accordingly. For example, when Sofia's input in English rose, her MLUw and upper bound in English improved as well. On the other hand, when her input in Italian dropped, her proficiency in Italian decreased as well. However, the same was not observed in the relationship between Sofia's Slovak input and proficiency. While Sofia's input in Slovak went down from 46% to 40% between the ages of 3;01 and 3;11, her MLUw and upper bound continued to improve. This finding suggests that perhaps the change in Sofia's Slovak input was not significant enough or that, once the quantity of input passes a certain threshold, language proficiency continues to improve despite negative changes in exposure.

An interesting finding about Sofia's language proficiency at the age of 3;01 is related to her productive skills in Italian and Japanese. Even though Sofia had comparable amounts

of input in both languages (26% of input in Italian and 22% of input in Japanese), her proficiency in the two languages was considerably different. Her MLUw as well as upper bound scores suggest that her productive skills in Italian were significantly stronger than in Japanese despite the fact that Sofia started having regular input in Italian a year and a half later than in Japanese. Based on the reviewed literature, it seems that Sofia's variety of contacts in each language played a role in her acquisition of Italian and Japanese. While Sofia had the opportunity to use her Italian with her teachers and other children at daycare every day, her exposure to Japanese was only from her father. Maneva (2004) and Chavelier (2015) both found contact variety, especially peer contacts, to play an important role in active multilingualism, which seems to be the case in the present study as well.

Another unexpected finding about Sofia's productive skills is related to her input and proficiency in English at the age of 3;01. Despite having only about 5% of direct input in English, Sofia was able to hold simple conversations with English speakers, using mostly 1–2-word utterances. Based on Quay (2001), a child needs at least 20% of input in a language in order to be able to actively speak it. Here the question is whether or not indirect input counts as part of the 20%. If it does, our finding is consistent with Quay's conclusion regarding the minimum amount of exposure to a language in order to achieve productive skills in a language. However, if Quay's (2008) estimation does not include indirect input, which is more likely the case, then our finding about Sofia's productive skills in English at the age of 3;01 is contrary to Quay's (2008) findings.

Consistent with previous research in the field of multilingual language acquisition, findings about Sofia's language input in relation to her proficiency in Italian, Japanese and English suggest that the quantity of input alone does not determine language proficiency. The findings from the present study indicate that the variety of contacts, especially peer contacts, have the potential to affect productive quadrilingualism as well. Sofia's proficiency in Italian

at the age of 3;01 and her proficiency in English at the age of 3;11 serve as two examples of how contact variety, especially peer contacts, can affect productive language skills. In the first case, Sofia's Italian skills were comparable with her Slovak skills despite the fact that she had 20% more exposure to Slovak than to Italian. However, the number of Sofia's contacts in each language shows that she had significantly more Italian contacts, especially peer contacts, than Slovak contacts, which likely affected her productive skills in each language. Similarly in the second case, Sofia's English skills quickly surpassed her Slovak skills despite the fact that she had similar amounts of input in both languages. Again, the number of contacts in each language likely affected Sofia's productive skills in Italian as well as in English.

While we only focused on input quantity and contact variety in the present inquiry, there are other possible factors that could have affected Sofia's language acquisition.

CHAPTER 6: CONCLUSION

The present research project focused on the examination of a 3-year-old girl's productive levels of quadrilingualism and the effects of language input on productive quadrilingualism. The participant in this longitudinal case study, Sofia, was regularly exposed to Slovak, Japanese and English from birth and Italian from the age of 18 months.

The data analysis revealed that Sofia comprehended all four languages both at the age of 3;01 and 3;11. Her dominant languages at the age of 3;01 were Slovak (language used with her mother) and Italian (language used at daycare), followed by English (language of communication between her parents and some friends) and Japanese (language used with her father). When Sofia moved from an Italian-speaking daycare to an English-speaking pre-kindergarten, her language input changed significantly, which had an effect on her productive skills in each language. By the age of 3;11, Sofia's dominant language was English, followed by Slovak, Italian and Japanese. While she was able to have conversations in English, Slovak and Italian to various extents, Sofia's ability to express herself in Japanese was too limited in order for her to be considered a productive quadrilingual. As a result, we concluded that Sofia was a receptive quadrilingual and a productive trilingual at the age of 3;11.

Two findings from this study are of particular relevance to the field of quadrilingual language acquisition. One concerns the effect of language input on productive levels of quadrilingualism. Our findings suggest that when the amount of input in a particular language changes significantly, the productive skills in that language change accordingly. For example, between the ages of 3;01 and 3;11, Sofia's input in English increased significantly, which had a visible effect on her ability to express herself in English. Sofia went from using mostly single words in English at the age of 3;01 to constructing a variety of sentence structures with a wide range of vocabulary at the age of 3;11. On the other hand, with a significantly decreased input in Italian, Sofia's productive skills in Italian declined sharply. Similarly, her

Japanese productive skills also weakened as a result of a reduced amount of input in Japanese. Inconsistent with the previous findings, a slight decrease in Sofia's Slovak input between the ages of 3;01 and 3;11 resulted in further development of her productive skills in Slovak. It is likely that Sofia's Slovak continued to improve because her input in Slovak remained high (40%).

The other finding from this study that deserves to be highlighted is related to the effects of contact variety, especially peer contacts, on productive levels of quadrilingualism. Consistent with the findings in other studies, Sofia's productive skills in Italian at the age of 3;01 were likely affected by the number of peer contacts she had at daycare. Even though her input in Italian at that age was significantly lower than her input in Slovak, Sofia's ability to produce both languages was comparable. We argue that this was due to the higher number of her Italian-speaking contacts (mainly peers) than her Slovak-speaking contacts. Another example of the effect of peer contacts on productive skills in this study is Sofia's dominance in English at the age of 3;11. Even though Sofia only started having regular direct input in English at the age of 3;04 and her input in English was not significantly greater than her input in Slovak, Sofia's dominant language by the age of 3;11 was English. Again, it seems that the variety of Sofia's English-speaking contacts had an effect on the quick improvement of her productive skills in English. Both of these findings suggest that contact variety, especially peer contacts, play an important role in productive quadrilingual language acquisition.

The findings from the present study have to be seen in light of some limitations. First of all, our case study with a single participant is not representative of the whole population of early quadrilinguals and provides little basis for generalizations of our findings to the wider population of children raised with four languages. Secondly, because the participant in this study is related to the researcher, there is a possibility of bias. To reduce partiality as much as possible, we chose not to rely only on the researcher's *observations* of the participant. We

used language diaries to get a more objective measure of the participant's language input and video recordings of the participant with four interlocutors to calculate her MLUw and upper bound in each language. Another limitation of this study has to do with the lack of research in the field of early *quadrilingual* language acquisition and our heavy reliance on studies examining early trilingualism. Considering the fact that early trilingual competence is not exactly the same as early quadrilingual competence, we had to be cautious when making comparisons between studies examining children growing up with three as opposed to four languages.

Considering the fact that the number of children raised with four languages is likely to grow in the next years, the field of early quadrilingual language acquisition would greatly benefit from more research in order to gain a deeper understanding of the nature of quadrilingualism in early childhood. Of particular interest would be the study of other factors that have the potential to affect simultaneous learning of four languages, cognitive effects of early quadrilingual acquisition as well as quadrilingual language maintenance in adolescence and adulthood. In addition, an examination of similarities and differences between trilingual and quadrilingual competences would enrich research in the field of multilingualism.

Raising children with four languages is a challenging endeavor, especially if parents aim to achieve active levels of quadrilingualism in their offspring. Even though the participant in the present case study lacked sufficient productive skills in one of her four languages at the age of 3;11, there is no reason to presume that productive quadrilingualism in early childhood is unachievable. Based on our findings, we have reason to believe that, with a more balanced input in all four languages and a higher number of peer contacts in her weakest language, Sofia has the potential to become productively quadrilingual in the future. In conclusion, we hope that this study can serve as a stepping stone towards a deeper understanding of the complexities of early quadrilingual language acquisition.

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APPENDICES

Appendix A: Language Diary Sample Page

Day 1

Time	Language(s) to which the child is exposed to	People who interact with the child	Type of activity
6:00			
6:30			
7:00			
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