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A comparative study on the development of explanatory abilities in South African Bantu languages

A dissertation submitted to the University of the Witwatersrand in partial fulfilment of the degree of Masters in Linguistics

By

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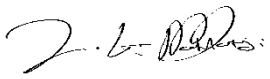
30 March 2025

Declaration

In submitting this dissertation electronically, I, Thupetsi Lucky Mahlatji, declare that the entirety of the work contained is my own, original work; that I am the owner of the copyright of the content contained herein, unless as stated otherwise; and that I have not previously submitted or published any part of it for the purpose of obtaining any qualification at any other institution.

Thupetsi Lucky Mahlatji

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30 March 2025

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Lastly, I would like to thank the Blues artists for their music: Muddy Waters, Sonnyboy Williamson, Lightinin' Hopkins and Freddie King. Their music always reminded me in this journey that I am just a regular guy who has the Blues!

With love and respect, this dissertation is dedicated to my grandmother, Joyce Mmamma Setshedi, and my sister, Thoriso Setshedi. Though they are no longer with us, their memories continue to shine brightly in my heart.

Abstract

The ability to generate explanations is not exclusive to adults and scientists. From as young as 3 years of age, children not only seek explanations by asking questions, but also construct their own explanations (Legare, 2012). Their explanations provide an insight into what they know and enhance their learning. Since their ability to generate explanations aids in learning new information, children are often able to focus on events that trigger causal, hypothesis-formulation, procedural, and theory of mind knowledge, eliciting explanations from them based on the triggered knowledge.

The present study focuses on the effects of language on explanatory skills. This aims to examine how explanations are produced by speakers of isiZulu, Sesotho, and Tshivenda, (South African Bantu languages), who are between the ages of 5– 6 years and 9–10 years. It is an intra-comparative study that investigates if explanatory abilities in children are language specific or universal. Participants watched a short wordless *Tom and Jerry* cartoon and were asked questions related to it (Colletta et al 2015, Kunene Nicolas 2015, Alamillo et al., 2013). These questions aimed at eliciting four different types of explanations i.e., hypothesis-formulation explanation, theory of mind explanation, procedural explanation, and causal explanation.

The results of the study demonstrate that the type of explanation has a hierarchical developmental stage as not all types are developed at the same time. The Causal explanation type shows an early stage of development and other types such as Hypothesis Formulation explanation show a more complex trajectory. Furthermore, the results show that gesture develops in tandem with speech. There is a developmental trajectory in the ability to generate gestures that represent and those that structure speech and highlight linguistic units. The results demonstrate that as children mature, they become more adept as being able to clarify encoded linguistic information through gestures.

Keywords: Explanations, Hypothesis Formulation, Procedural, Theory of Mind, Causal, Gesture, Late language development, Bantu languages

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Chapter 1 – Introduction

1.1 Background Study

This study embarks on a novel exploration of the development of explanatory skills in South African Bantu languages. The concept of explanatory skills has garnered significant attention among scholars across various disciplines, including linguistics and psychology (Alamillo et al., 2013; Lombrozo, 2006; Wellman, 2011, amongst others). These skills are crucial as they play a vital role in enhancing children's learning processes. While extensive research has highlighted the development of explanation in children speaking languages like French (Colletta & Pellenq, 2009; Alamillo et al., 2013), a gap remains in the literature regarding how explanations evolve in children who speak Bantu languages. This study aims to fill that void, contributing valuable insights to our understanding of language and learning within diverse cultural contexts. Research has documented that children are capable of constructing explanation-rich naïve theories (Wellman & Gelman, 1998) and actively pursuing explanatory information (Gopnik, 1998). Furthermore, there is a substantial body of developmental literature demonstrating that children actively seek explanations (Callanan & Oakes, 1992). In their study, Callanan and Oakes (1992) revealed that adults vary their approach to providing explanations in response to children's queries, depending on the child's age. Notably, mothers of 3-year-old children provided causal explanations approximately 32% of the time, while mothers of older children employed this type of explanation at a rate of 50%-60% (Callanan and Oakes, 1992). Such studies demonstrate that children look for explanations from adults around them about different things that they do not understand. However, children not only ask questions, but they are capable of providing explanations (Legare, 2012; Legare et al., 2010). Different scholars have demonstrated that children are able to produce explanations from an early age of two, and they begin to differentiate explanations from non-explanations by the age of three (Callanan & Oakes, 1992; Frazier et al., 2016).

Explanatory discourse not only illuminates children's existing knowledge but also serves as a catalyst for learning and cognitive development (Wellman & Liu, 2007; Lombrozo, 2006; Crowley & Siegler, 1999). Indeed, studies have shown that when children are tasked with explaining events, their learning is enhanced beyond the simple provision of feedback on the accuracy of their predictions (Siegler, 1995; Amsterlaw & Wellman, 2006). Moreover, the findings of Walker et al., (2014) demonstrate that prompting children between the ages of 3 to

5 years old to explain why objects make a machine function leads them to prioritize causal properties over appearance when categorizing and generalizing internal properties, highlighting the cognitive benefits of engaging in explanatory discourse (Frazier et al., 2016). Taken together, these findings suggest that explanatory discourse is a rich and complex learning process that has the potential to not only reveal children's current understanding, but also to deepen their understanding through engagement in the process of explanation itself.

Despite the acknowledged importance of explanation during early childhood, however, little is known about the development of different types of explanation during late language acquisition. Scholarly work has shown that children are able to produce different types of explanations such psychological, causal, mechanical, biological explanations (Colonnesi et al., 2008; Wellman & Lui, 2007, Legare & Clegg, 2014; amongst others). In their study, Colonnesi et al., (2008) demonstrated that children are capable of producing psychological explanations. They showed that young children preferred to use psychological explanations and above all desire-belief explanations instead of behavioural explanations in giving reasons for human behaviour.

1.2 The present study

1.2.1 Explanatory Abilities

The present study aims to investigate the development of explanatory abilities in South African Bantu languages from a multimodal perspective. Although much research has been conducted in the literature, as shown above, none focuses specifically on Bantu languages. Therefore, this study will apply a multimodal approach to investigate isiZulu, Sesotho, and Tshivenda. Furthermore, it will examine the development of these explanatory skills in children speaking these Bantu languages during late language acquisition, considering both verbal and non-verbal cues through co-speech gestures. The study will involve 5-6 year old and 9-10 year old children who speak either isiZulu, Sesotho, or Tshivenda groups. In addition to the insufficient inquiry into the explanatory skills of South African children, this study aims to test existing theories and models that are predominantly based on languages from the Global North ‘WEIRD’ (Western, Educated, Industrialized, Rich and Democratic) and do not consider the Bantu language family (Aravena-Bravo et al., 2024).

As mentioned above, children are capable of producing their own explanations, and there are many different types of explanations (Callanan & Oakes, 1992; Colonnesi et al., 2008). This study will, however, focus on four different types of explanations. These are: Hypothesis Formulation, Procedural, Theory of Mind, and Causal explanation types. Since their ability to

produce explanation aids in learning new information, children can be able to focus on events that trigger hypothesis formulation, procedural, theory of mind, and causal knowledge, eliciting from them explanations based on the triggered knowledge.

Additionally, this is an intra-comparative study that seeks to investigate whether the explanatory ability development in children is language specific or language universal. As far as the researcher is aware, this is the first study that makes a comparison of explanatory ability development in children who are native speakers of isiZulu, Sesotho and Tshivenda. All these languages belong to the Bantu languages family and are spoken in South Africa; however, they do not belong in the same language clusters. IsiZulu belongs in the Nguni group, the Sesotho group belongs in the Sotho-Tswana group, and, lastly, Tshivenda is a non-clustered language (Van der Merwe & Le Roux, 2014) These three languages are not mutually intelligible.

1.2.2 Multimodality of the study

This study applies a multimodal perspective in the investigation of explanatory skills. Speakers do not rely only on speech. Communication also depends on expression; therefore, it is important to comprehend both verbal and non-verbal parts of communication (McNeill, 1992; Kunene Nicolas 2010; Scherr, 2008). Speech and gesture are produced simultaneously. When we speak, we produce gestures at the same time. This means that gesture and speech influence each other. McNeill (1992) posits that speech and gesture express two aspects of thought – the verbal and the imagistic. These modalities either represent the same entities or they complement each other whereby an aspect of speaker's thoughts not communicated verbally may be communicated through gesture. Scherr (2008) also argued that speech is accompanied by gestures which also disclose mind since they convey ideas and acts that may or may not be communicated vocally. Additionally, gestures can convey meaning in ways that speech cannot (Scherr, 2008).

In this study, the aim is to explore how co-speech gestures facilitate explanations. While the development of explanatory ability is of critical interest in the context of later language development, relatively few researchers have explored this topic using a multimodal approach, with only a handful of studies having examined explanatory behaviour through a multimodal lens (e.g., Colletta & Pellenq, 2009; Alamillo et al., 2013). This dearth of research on explanatory behaviour within the realm of multimodality creates a notable gap in our understanding of how children communicate and develop explanatory skills across different modalities, particularly in the context of late language acquisition. In their study, Colletta and

Pellenq (2009) investigated the production of explanations by French children aged 3 to 11 years. Their results provide evidence for the existence of developmental changes affecting the multimodal construction of explanations. Literature on gesture-speech combination is important as it shows that speakers do not only rely on speech. Our study aims to add into this literature by focusing on South African Bantu languages – isiZulu, Sesotho, and Tshivenda.

1.2.3 South African Educational Landscape

Explanations are vital in scholarly success as children are usually tested in comprehension tasks in schools. The South African education landscape shows that there is a low literacy rate. Most recent findings reveal that the number of school children who cannot read for meaning has increased since 2016 (Morris, 2024). The author further states that that over 80 per cent of Grade 4 learners (aged 9–10) in South Africa are unable to read for meaning despite oral proficiency in their home language and potentially other languages. This highlights a deficit in literacy in South African education, indicating that while young learners may have developed oral communication skills in their native languages, they remain illiterate, unable to decode or comprehend written text (Morris, 2024).

Despite the efforts that the government has made to reduce this high rate, not so much has changed, especially in rural areas (Cilliers & Bloch, 2018). Scholars show that literacy, especially reading literacy, is important as it forms the foundation of scholastic success at primary, secondary, and tertiary level (Naidoo et al., 2014). A literate individual can develop capacities of reflection, critique and empathy that consequently lead to a sense of self-sufficiency and identity (Cilliers & Bloch, 2018). This study notes that in comprehension tasks, children need to be able to read and understand what they have to read in order to write and explain to themselves or to another person.

1.3 Aims of the study

The present study focuses on the effects of language and age on explanatory skills from a multimodal perspective. This aims to examine how explanations are produced by speakers of isiZulu, Sesotho, and Tshivenda who are between the ages of 5–6 years old and 9–10 years. It is an intra-comparative study that investigates if explanatory abilities in children are language specific or universal. There is a dearth of information on what happens to Bantu language speaking children during late language acquisition.

As it is well established in cognitive science, language is not just expressed in verbal mode, but also encompasses non-verbal cues that children have to learn and master. With the challenges of literacy and numeracy skills in South African children, it is now vital to fully understand how children process language to facilitate in teaching and learning. This study will look at explanations, how children respond when asked a question in order to investigate how knowledge, and information is processed.

IsiZulu and Sesotho are some of the Bantu languages in South Africa that have been studied from a multimodal developmental perspective (Kunene Nicolas, 2015; Ntuli, 2016). However, these studies were on oral narrative discursive performance. By investigating the explanatory discourse of children from three understudied languages—isiZulu, Sesotho, and Tshivenda—through a multimodal lens, this study aims to fill a significant gap in our understanding of how these languages employ gestures as part of their communicative strategies. This research will provide new insights into language and gesture development within these communities, offering valuable contributions to the broader field of human communication.

1.4 Rationale

The rationale behind this study lies in the fact that languages that belong to the Bantu language family are invariably understudied with regards to intra-typological patterns and even less on explanatory trajectories in late language acquisition. This gap in knowledge hinders our understanding of how children from these communities formulate explanations, which are crucial in scholarly success. By examining explanatory discourse in three Bantu languages – isiZulu, Sesotho, and Tshivenda – this study seeks to address this gap and make valuable contributions to the field.

Firstly, the study intends to contribute to our understanding of the cognitive processes and linguistic strategies children employ when explaining concepts, shedding light on how children's explanatory skills develop over time. Secondly, by examining explanatory discourse in three related, but distinct, Bantu languages, the study provides a basis for intra-typological comparison, which can help us identify both commonalities and differences in explanatory practices across these languages. This could yield valuable insights into the shared features of Bantu languages, as well as unique characteristics that set them apart. Lastly, by considering Bantu languages in the context of existing typological theories, the study can both strengthen existing models and identify gaps or exceptions. As a consequence, the study aims to contribute

to our understanding of the typological diversity within this language family, which could lead to more nuanced and comprehensive theories of linguistic variation and language development.

By examining explanatory discourse in isiZulu, Sesotho, and Tshivenda, this study offers an opportunity to deepen our understanding of language and cognition across different cultural and linguistic contexts.

1.5 Research Questions

1. How are multimodal explanations produced by isiZulu, Sesotho, and Tshivenda speakers?
2. Does age affect multimodal explanatory skills in isiZulu, Sesotho, and Tshivenda?

1.6 Outline of the study

Chapter 1: Introduction

This chapter provides a background on the production of explanations in children in the discourse literature. It discusses how children are able to provide different types of explanations from an early age. It further notes that children are not only explanation seekers but are also capable of providing their own. This chapter introduces the interest of this study, stating why it is imperative to investigate this interest. Furthermore, the chapter provides the aims and rationale of the study, justifying its importance. Lastly, it provides the research question of the study.

Chapter 2: Literature Review

This chapter provides an overview of Bantu languages. It further gives an overview of the three languages, isiZulu, Sesotho, and Tshivenda, focusing on their differences and similarities. Furthermore, this chapter discusses related previous work on explanatory abilities and speech-gesture combination, demonstrating how previous work relates to this study.

Chapter 3: Methodology

The methodology chapter discusses the method used in this study. It discusses how the data was collected and coded. Furthermore, it describes the procedures and tools such as software used in annotating and analysing the collected data.

Chapter 4: Results and Analysis

This chapter provides a quantitative analysis of the data. It provides and explains the results of clauses, different types of explanations and co-speech gesture. This quantitative analysis is on both language and age.

Chapter 5: Discussion and Conclusion

This chapter provides the interpretation of the findings and summarises the results. It also provides the limitations of the study and future directions. Lastly, it describes a conclusion reached from carrying out this study.

Chapter 2 – Literature Review

2.1 Introduction

The ability to produce explanations is not exclusive to adults, or particularly, scientists. Children are not only explanation seekers, but they can also provide their own explanations. This ability to produce their own explanations enhances their knowledge acquisition. This implies that the explanations that children produce facilitate their learning. This study examines the development of explanations in children speaking South African Bantu languages – isiZulu, Sesotho and Tshivenda. It investigates the explanatory skills development in children speaking these Bantu languages during late language acquisition from a multimodal perspective which will look at both the verbal and non-verbal cues in the form of co-speech gesture. This chapter reviews existing literature of the explanatory skills in children. It begins by discussing the nature of Bantu languages, and this is subsequently followed by the explanatory skills in children, and co-speech gesture literature.

2.2 Overview of Bantu languages

The Bantu language family is found in Africa. This language family has over 400 languages (Creissels et al., 2019). These languages in the literature are often referred to by a combination of letter and number. For instance, Northern Sotho is referred to as S32. This system of referring to the languages is based on Guthrie (1967, 1971). It is a complex system that divides Bantu speaking areas into different zones. According to Greenberg (1972), the Bantu language family developed between the countries of Nigeria and Cameroon and broke away from the Niger-Congo language family. The Bantu language family extends to Kenya in the northeast, South Africa in the south, and the Nigerian-Cameroonian borderland in the northwest of the Bantu-speaking region (Marten, 2020). The map at Figure 1 shows the distribution of Bantu languages in Africa. There is a debate in the literature as to what defines Bantu typologically. However, recently, there has been a convincing consensus on how to describe this family typologically. Bantu languages show some remarkable typological characteristics. This relative typological homogeneity is owing to the continuous contact among them (Creissels et al., 2019). Creissels et al., (2019) further advances that the basic phonological and morphosyntactic structural characteristics in Bantu languages carried from Proto-Bantu are not equally distributed across all languages in the language family.

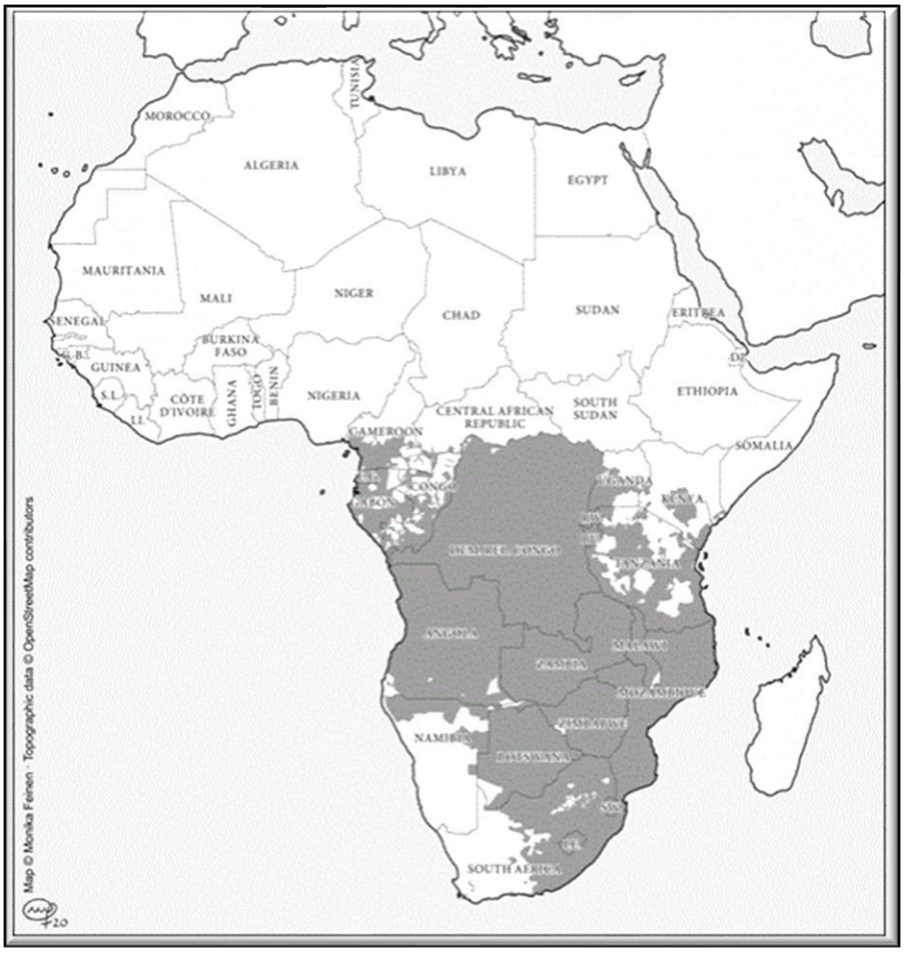


Figure 1: The distribution of Bantu languages in Africa

Beginning with the phonological characteristics, most Bantu languages typically have plosives (voiced and voiceless), fricatives that are common cross-linguistically, nasal sounds, two approximants, and liquid sounds (Creissels et al., 2019). Most languages in the family have five or seven phonemic vowels. For instance, Northern Sotho (S32), a Bantu language spoken in South Africa, has seven vowels (a, e, ɛ, i, o, ɔ, u), and isiXhosa (S41), another Bantu language spoken in South Africa, has five vowels (a, e, i, o, u). Creissels et al., (2019) notes that there are also distinctive nasalised vowels, however they are not common in Bantu languages. The author advances that a limited set of western languages, like Teke (B70) and Bembe (H11), as well as southern languages, including Yeyi (R41), include these vowels. The syllable structure of these languages in the Bantu family maintain the syllable structure that is open. Some languages such as Northern Sotho (S32) have the syllabic nasal. The locative suffix is common in such languages, especially in the Sotho-Tswana language group (S30).

Morphologically, Bantu languages are agglutinating. Nouns in the languages of this family have stems and an obligatory prefix that expresses singular and plural distinction, and the

distinction between words that are semantically related, sharing the same stem, but have different agreement qualities and inflectional morphology (Creissels et al., 2019). These languages have nouns that are assigned to a class. For instance, in Sesotho (S33), a South African Bantu language belonging in the Sotho-Tswana group (S30), the word *motho* meaning 'a person' has a noun class and a noun stem. The noun class is *mo* and belongs to noun class 1, denoting that the noun is singular, and the noun stem is *tho*. Bantu languages have verbs that are morphologically complex, consisting of a root and affixes. Nurse and Philippson, (2003) state that the verb in these languages is crucial as it contains a lot of information and may carry a whole sentence by itself. The authors further state that almost all Bantu languages are prodrop.

Bantu languages have a basic order of sentence constituent: subject – verb – object, (Nurse & Philippson, 2003). Creissels (2019) observes that Nen (A44) is an exception since the object precedes the verb in this language. Given the agglutinative nature of Bantu languages, syntax and morphology are never completely separated. The subjects and object prefixes in languages belonging to this family agree with the referents (van der Wal, 2022). According to Marten and van der Wal (2014), subject marking is required, although the quantity and optionality of prefixes used for object marking vary. As stated, Bantu languages are called prodrop languages since the subject can be omitted. This means that they tend to 'drop' pronouns in certain contexts. Further evidence that Bantu languages exhibit substantial verbal morphology, not just for derivation but also for inflection comes from Marten and van der Wal (2014). This occurs through the use of suffixation. For verbal derivation, different suffixes can be inserted in between a verb stem and the final suffix (Marten & van der Wal, 2014).

2.3 South African Bantu languages

South African languages belong to the Zone S of Guthrie's classification (see Figure 2). Languages in this zone have a large consonant inventory. Gowlett (in Nurse & Philippson, 2003) states that sounds such as lateral stops, affricates and fricatives are common in Zone S languages. Click sounds are found in languages such as isiNdebele, isiZulu and isiXhosa in this zone. The author advances that languages such as Southern Sotho and SiSwati only have the alveolar click sound. Languages in this zone have five vowel systems, except for Sotho-Tswana languages. These languages have nine distinctive vowels. The canonical syllable structure of these languages is CV. Having given this brief description of South African Bantu languages, which show typical characteristics of Bantu languages, the study that follows discusses languages that are of interest.

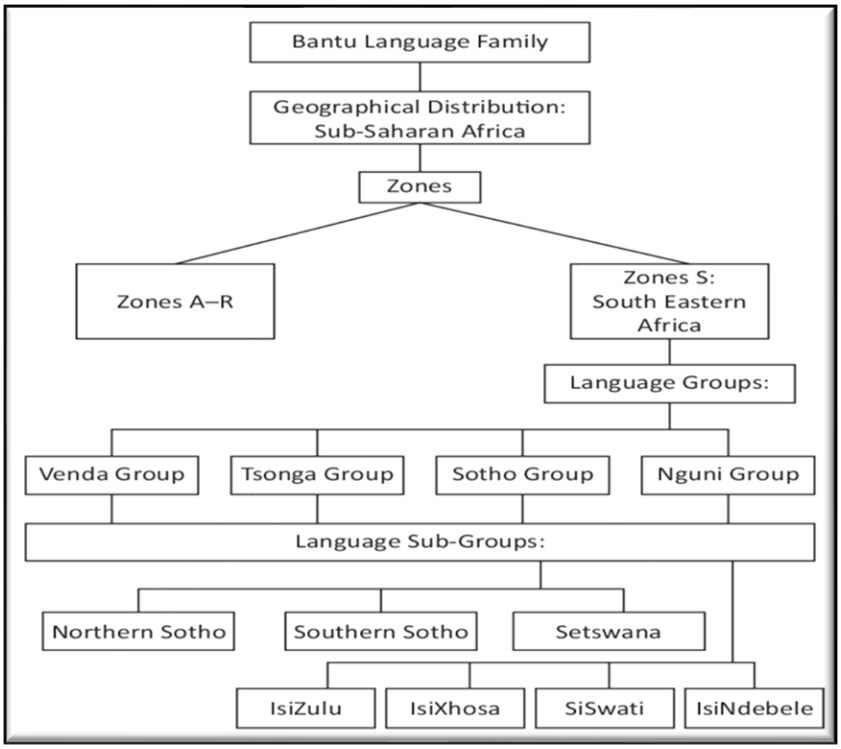


Figure 2: Languages found in the Zone S in Southern Eastern Africa

2.3.1 IsiZulu

The Zulu language (S42) is spoken mainly in KwaZulu-Natal. The speakers of the language are also spread around other parts of South Africa. The language is the most spoken language in the country. According to the South African Statistical data (2018), 25.3 per cent of individuals in the country speak the language as a home language. IsiZulu uses a conjunctive writing system, and like other Bantu languages, it uses a typical SVO word order. The language falls under the Nguni language sub-family (S40). According to scholars such as Demuth and Suzman (1997) and Kunene Nicolas and Ahmed (2016), isiZulu is classified as a pro-drop language. This allows the speakers to omit pronouns in sentences while the nominal and verbal modifiers adhere to specific syntactic ordering, with grammatical morphology affixed to both the noun and verb.

2.3.2 Sesotho

Sesotho (Southern Sotho) (S33) is a language that is mostly spoken in Lesotho and surrounding regions of South Africa. It is an official language in South Africa, along with isiZulu and Tshivenda, and falls under the Sotho-Tswana language sub-family (S30). In this language family, Sesotho is closely connected to its sister languages, Northern Sotho (Sepedi) (S32), and Setswana (S31). According to Doke and Mofokeng (1985), the language has a fundamental SVO (Subject-Verb-Object) word order. Like Tshivenda and the other two languages in the

Sotho-Tswana language family, Sesotho uses a disjunctive writing system. The language in South Africa is spoken by 7.9 per cent of individuals as a home language (Statista, 2018).

2.3.3 Tshivenda

The Venda language (S21) is mostly spoken in the Limpopo region. Several urban locations in the Transvaal, as well as the rural surroundings, are home to a significant population of Venda people (Poulos, 1990). Tshivenda verbs are constructed from a number of prefixes and suffixes that are arranged around the primary root, just like those in other Bantu languages. Tshivenda uses a disjunctive system of writing, as opposed to isiZulu's conjunctive system. The language follows the fundamental SVO word structure like other Bantu languages. The language in South Africa is spoken by 2.5 per cent of the population as a home language (Statista, 2018).

2.4 Late language development

The development of language has no obvious point of completion. Language development was thought to be complete in children when entering school, however, recent studies have shown that this is far from true (Colletta & Pellenq, 2009). These studies have made it apparent that language acquisition is an ongoing process that occurs in school-age years, adolescence and even in adulthood (Wassenberg et al., 2007, 2008; Nippold et al., 1998). From the early stages of cooing until the age of 5 and 6, children demonstrate a great deal of early language acquisition. This is seen in the fact that they are able to produce short simple utterances that may have a few grammatical errors. Nippold (2008) states that this early language development in children starts and develops through stages of cooing, babbling and proto-word formation. This is preceded by the stage when toddlers begin by making requests and commenting on the world around them using their first words such as “Hey!” or “Doggie”. The author further states that language development is not a static process, but rather a continuous and dynamic process throughout a lifetime. With the accumulation of life experiences, cognitive skills, metalinguistic awareness, social interactions, and literacy skills, language acquisition progresses in complexity and sophistication, highlighting the crucial role of ongoing developmental process in shaping language abilities (Nippold, 2008).

For instance, when observing syntactic development, hierarchical development patterns between younger children and older children are apparent. In a study performed by Colletta and Pellenq (2009), the authors noted that there is a difference in the number of connectives and clauses that children produce in their sentences. Their results demonstrate that older children had an increased number of connectives and clauses in their sentences (explanations)

when compared to younger children. This is to be expected since older children are more cognitively advanced than younger children. The results of the study show that children can use these devices in a more fluent and efficient manner to produce larger chunks of discourse. The results of Wassenberg et al., (2008) are also congruent with literature in the fact that there is a hierarchical developmental pattern in the study of younger children and n relation to older children. In their study, the authors demonstrated that there is an increase in language comprehension growth pattern between lower and upper grades and not all aspects of language comprehension are mastered at the same time. Their results show that complex language comprehension continues to advance till of adolescence. In addition to this, they indicate that 14-year-old adolescents were unable to fully comprehend complicated words by the time they reached eighth grade, implying that sentences were too challenging. This result implies that language acquisition has no point of completion since children of this age are not yet able to comprehend challenging sentences.

Not all signs of late language development are syntactic in nature. Pragmatics also demonstrates that language acquisition is continuous and does not stop in early stages of development. Pragmatic development is apparent in several communication genres, such as conversational, narrative, and persuasive discourse (Nippold, 2008). During the years of adolescence, conversational skills are important, and they are known to improve throughout the years. These skills are marked by cohesion, contributing novel ideas, emphasising key points through dramatic gestures and facial expressions, and others (Nippold, 2000). Narrative studies have demonstrated and strongly supported that children of different ages do not narrate a story the same way. As story narration represents a multifaceted language production task, research on oral and written narration has revealed age-related differences in narrative skills. Adults, with their more mature language abilities, are expected to craft lengthier and more detailed narratives compared to adolescents, who in turn, produce narratives that surpass those of younger children in terms of depth and complexity. In their study, Colletta et al., (2010) investigated the nature and strength of the developmental changes that occur in the use of language and co-speech gesture in narration. The findings of this study show that older children produce longer narratives than younger children. Furthermore, they demonstrate that adults used more complex syntax and complex discourse markers than ten-year-old children, and the ten-year-old children used complex syntax and complex discourse markers than the six-year-old children (Colletta et al., 2010).

Coupled with communicative tasks, gesture studies have also shown that the use of gestures in communication increases with age (Colletta et al., 2010; Kunene Nicolas 2015). Language and gesture are not separate. Studies have shown that language and gesture are equal partners, and they develop together in language acquisition. In these studies, authors have shown that the communicative signals produced by children are expressed in both modalities, gestural and vocal. Studies of gesture have demonstrated that individuals vary in their manner of gesture (and speech). For instance, Kunene Nicolas (2015) has shown that there is a developmental trajectory with the adults producing more gestures with additional information than children. The 9 – 10 year-old group produced more gestures than the 5 – 6 year-old group; however, the difference was not that significant (Kunene Nicolas 2015). This shows that gesture rate increases with age.

The study aims to investigate the explanatory development in two age groups (5–6 years age group and 9–10 years age group) to ascertain whether the observed patterns align with established trends in the late language development literature. The findings of this study will contribute to the existing body of knowledge on explanatory development. Based on the reviewed literature above, this study hypothesizes that there will be a difference between the two age groups in terms of gesture and the production of the communicative task.

2.5 Explanations

It is evident that language development extends well beyond the early childhood years , as the processes of learning and refining communicative abilities persist throughout the school years and beyond. This study focuses on the development of explanatory skills in children during late language acquisition, which continues to unfold even after the early childhood period. Although young children may not yet possess the skills to produce written explanations, their oral explanatory skills are still evolving, making them suitable for investigating the development of explanatory skills during late language acquisition. Their first production of explanations appears before the end of their second year (Veneziano, 1998). However, Colletta and Pellenq (2009) assert that these are not explanations, but justifications for their actions, requests, and behaviour. Explanations are defined as interrogatives that seek clarity on the description of a particular concept or object, how things work and the reason why that object or concept occurs in the particular manner (Drake & Jess, 2018). Halpern and Pearl (2008) see explanations as a fact that is not certain but as a legitimate cause of something to be explained. Colletta and Pellenq (2009) concur with this definition in that they observe explanations as

having an *explanandum* and *explanans*. An *explanandum* is a phenomenon that needs to be explained, and *explanans* are causes, reason, or motivations for this phenomenon or behaviour (Hempel & Oppenheim, 1948; Veneziano, 1998; Colletta & Pellenq, 2009).

Explanations provide an interesting reason for study. As stated above, they appear in the late second years in children. It is interesting to observe that these are just justifications and do not have the specific connector "because" (Colletta & Pellenq, 2009). Studies have shown that this connector is apparent in children's third year (Veneziano & Sinclair, 1995; Diessel, 2004). What is even more interesting in these years is that children rarely produce the *explanandum* in their 'explanations'. As a result, the adult has to identify it himself or herself in the context (Colletta & Pellenq, 2009). Furthermore, another intriguing reason is that explanations are seen as facilitating learning in children. The question of how explanations do this is of importance.

Studies in explanations have shown that explanations that children produce and facilitate their learning (Legare & Gelman, 2014). Scholars have observed that explanations enhance knowledge acquisition by prompting children to speculate about internal unobserved mechanisms and causal functions (Legare & Lombrozo, 2014; Legare et al., 2010). Furthermore, these studies have shown that explanations have selective impacts, and they do this by inspiring young children to think about a specific type of hypothesis, namely one that concurs with a good explanation (Legare & Lombrozo, 2014). For instance, Legare and Lombrozo (2014) conducted two studies on how and why explanations promote learning in young children. The authors examined the distinct and targeted impacts of explanations in comparison to other tasks that require comparable cognitive engagement. The authors sought to understand the differences between explanations and other processes that need active participation, such as descriptions, as well as the spontaneous processing of information that takes place during observation. Children were shown a set of gears as part of this experiment, each of which had a handle that could be turned to turn on a fan on the other side (Legare & Lombrozo, 2014). The authors asked some of the children to explain the gear toy and told others to observe or describe the toy. Their findings revealed that the impacts of explanations differ from those of observation or other forms of verbalisation and had selective rather than broad learning benefits (Legare & Lombrozo, 2014). Furthermore, they demonstrated that older children are more likely than younger children to produce verbal responses that are classified as explanations. However, this result does not interact with the beneficial effect of explanations. The authors suggest that while older children might be more prone to engaging in explanation,

whether spontaneously or in response to prompts, the effectiveness of the explanation is primarily determined by its content and quality, rather than simply by a child's age (Legare & Lombrozo, 2014).

The results obtained by Legare and Lombrozo (2014) found themselves congruent to the results in the existing literature especially with the fact that older children are more likely to produce explanations than younger children. This is a developmental trend that already exists in the literature of language acquisition. Colletta and Pellenq (2009) found this developmental trend in terms of the structure or the syntax of the explanation in children. The authors observed that the age of children had an effect on the structure or the syntax of the explanations. They observed that older children produce complex explanations, and younger children produce simple explanations. This is an interesting observation because as children grow older their cognition develops and becomes richer. Furthermore, this shows that language acquisition is a long-term process that children embark on. It has no obvious point of completion. The fact that age has an effect on the structure or syntax of the explanations shows that children build on what they know in this process of acquiring language. This enables the child to grow cognitively. From the observations made by Colletta and Pellenq (2009), one can deduce that older children are more likely to produce these complex explanations owing to the fact that they are more cognitively advanced than younger children who produce more simple explanations.

Simple explanations are seen as having one or two (or more) clauses that are placed next to each other without having any logical link (Colletta & Pellenq, 2009). For instance, example (1) in French below only has one clause, and example (2) has two clauses; they are bound together by the connector "and". This connector, however, has no logical meaning in the speech turn.

(1) Girl, 4 years old:

Explanandum: pourquoi elle pleure la p'tite fille?

Why is the little girl crying?

Explanans: parce qu'elle est punie

because she was punished.

(2) Girl, 3.5 years old:

Explanandum: pourquoi tu dis que c'est de la fraise?

Why do you believe it's strawberry juice?

Explanans: parce que c'est rouge et ça sent la fraise

because it's red and it smells of strawberry.

Complex explanations are seen as having at least two clauses that are linked together logically (Colletta & Pellenq, 2009). For instance, example (3) in French demonstrates this structure.

(3) Boy, 5.5 years old:

Explanandum: pourquoi le ballon s'est-il envolé si vite?

Why did the balloon fly away so fast?

Explanans: parce qu'il a mis beaucoup d'air alors ça avance encore plus

because he put a lot of air in it so that it moves faster.

The study of Colletta and Pellenq (2009) is consistent with other studies that show that the cognition of children, during the process of language acquisition, develops and becomes richer as they grow older. This is also shown in the fact that older children, in this study, were more cohesive than younger children. Cohesion is linked with the cognitive development of a child. Cohesion is cognitively challenging in children, and is therefore, expected to have problems when creating a cohesive discourse (Lindgren & Vogels, 2018). Colletta and Pellenq (2009) have shown that as children grow older, their explanations contain more connectives. Their results demonstrated that explanations generated by older children had an increased number of connectives and clauses. This can be an expected result considering the fact that older children are more cognitively developed than younger children. Alamillo et al., (2013) observed similar results. The authors reported that the older children had more clauses in their explanations than younger children. It can be inferred that older children are more able to generate more clauses and are more able to connect them in order to form a cohesive discourse than younger children are. These studies add important information in this literature.

2.6 Explanations and Gesture

Language and gesture are equal partners. Gesture plays an imperative role in language and communicative development (Kunene Nicolas 2015; Macoun & Sweller, 2016). This dissertation, therefore, finds it imperative that it investigates the development of explanations

from a multimodal perspective. There are a few studies that investigated the development of explanations from a multimodal perspective (Colletta & Pellenq, 2009; Alamillo et al., 2013). Most of the studies that already exist have studied the narrative communicative activity from a multimodal perspective (Kunene Nicolas 2015, Colletta et al., 2010; amongst others).

Studies have indicated that children start to gesture before they can start talking (Guidetti, 2002). They are able to perform gestures such as waving, pointing, and nodding their heads. As they grow older, they begin to utter words and prefer this form of communication to gesturing. However, they do not stop performing gestures completely. Instead, they use gestures to reinforce the spoken message or even extend it. According to research on narrative and gesture, older children who can narrate, expand their repertoire of co-speech gestures by learning additional gesture forms and functions. They use these new gesture functions and forms to help them organise and tell their narrated story.

There is far less literature on the explanatory development in children from a multimodal perspective. The most studied communicative activity is narration. There is a wealth of information in this literature demonstrating that children are able to talk about past events from a young age. Furthermore, this literature shows that there are developmental changes that take place in school age children's narrative abilities such as linking sentences (Jisa, 2004), adjustment to the communication techniques used with the other person (Bamberg & Damrad-Frye, 1991), and other developmental changes. Additionally, a parallel developmental change in gesture use has also been observed in the literature of narrative and gesture. The question of whether there are effects of age and language on the multimodal explanatory skills during late language acquisition has received less attention.

Alamillo et al., (2013) added information after observing this gap in the literature. The authors made a comparison of the oral narratives and explanations produced by children in order to investigate the effect of age and task in their use of language and gesture. In this investigation, the participants took a narrative task followed by an explanation task. In the explanation task, children were asked questions that were related to the visual stimuli. Participants were asked to watch a short video cartoon and after watching this video they had to narrate. The timing of the explanatory task, which was immediately conducted after the narrative task, meant that the children had already engaged in a cognitively demanding exercise of recalling and describing the events depicted in the video. The findings of this study revealed that there was a difference in the discourse length between narratives and explanations. Furthermore, the authors reported

that the use of connectives is higher in narratives than in explanations. Additionally, the study showed that during explanation tasks, children's explanations were accompanied by more performative, framing, and interactive gestures (Alamillo et al., 2013). This is an interesting observation since some of these gestures are infrequent in narrative elicitation task studies (Kunene Nicolas, 2015). Kunene Nicolas (2015) reported that performative and interactive gestures were infrequent because of the nature of the task which was narration. This is because it is monologic and not dialogic. In the study of Alamillo et al., (2013), performative, interactive, and framing gestures in the explanation task co-occurred with speech acts. This showed that the use of gestures in explanations that children generated paralleled the use of speech. The current dissertation seeks to observe whether there might be similar findings in Bantu languages speaking children.

2.7 Types of Explanations

Explanations range over many phenomena and employ many reasoning systems. This means that people have many different reasons and explanations for things that happen. For instance, in order to fully understand something or explain an event, people need to look at the problem or topic from multiple angles. For example, if people wanted to explain how plants grow, they would need to consider many things like chemistry, physics, biology, etc. Each of these perspectives will offer a different way of thinking about plants, and together they paint a more complete picture. This shows that there are different types of explanations that someone might choose in order to explain how a plant grows. Scholarly work has shown that children are able to produce different types of explanations. These studies demonstrated that the explanations that children generate are important to the understanding of cognitive development (Frazier et al., 2016). As explained before, there are many different types of explanations that children are able to generate; however, this dissertation will only focus on Hypothesis Formulation explanations, Procedural explanations, Theory of Mind explanations, and Causal explanations.

2.7.1 Hypothesis Formulation Explanation

Children are curious, and they have the ability to explain unexpected phenomena (Legare et al., 2010). This curiosity leads them to explore and come with explanations on unexpected phenomena. As scholars such as Lombrozo (2006) have observed, producing explanations can improve casual learning and promote generalisation. Scholars such as Baldwin et al., (1993) have also observed that children can also learn from spontaneous exploration. Children's explanations help generate evidence relevant to disambiguate different causal variables (Cook

et al., 2011). This means that explanations guide explorations in seeking more information as it becomes available. Explanations are also hypotheses. This is seen in the fact that children are also able to provide the little data they have and provide explanations from them. For instance, a child might notice that a plant is not growing well, or it is wilting, and through exploring, they might come up with an explanation that the reason for that is because the plant is not getting enough water.

The claim that the learning and thinking of young children is similar to the learning and thinking in science is supported by many scholars in the literature of causal learning (Gopnik, 2012; Masnick et al., 2007; Sodian et al., 2002; amongst others). This claim argues that children test hypotheses against the presented data and are able to make causal inferences (Gopnik, 2012). Furthermore, more recent studies have revealed that young children are more adept at using scientific thinking than was previously thought (Zimmerman, 2007). It has been shown that children possess evaluation abilities and a basic understanding of how science works (Sodian et al., 2002). In a study performed by Köksal-Tuncer and Sodian (2018), the authors explored young children's comprehension of the relationship between causal hypothesis testing techniques and counter-argumentation skills. In this study, the authors demonstrated that children possess scientific reasoning abilities from an early age. Their research significantly expands the body of literature that is already in existence. Their results showed that when driven by a causal belief, young children not only engage in explanatory play that is variable and longer, but also that they use systematic testing techniques (i.e., contrastive testing, positive testing). Their results also demonstrated that young children can effectively refute a false causal claim by generating disconfirming data and making verbal counter arguments that are disconfirming of the false claim. The authors reported that this finding indicates that young children can distinguish between hypotheses and evidence and can combine the two. The findings further demonstrated that young children are not only capable of engaging in informative play interventions, as demonstrated in causal learning studies, but are also able to provide reliable proof that refutes a claim (Köksal-Tuncer & Sodian, 2018).

In the current study, the following question will be put to the participants in order to elicit hypothesis formulation explanations.

1. In the beginning of the cartoon, why does the mother bird leave the nest?

IsiZulu: *Ekuqaleni kwamapopayi, kungani inyoni engumama ishiya isidleke?*

Sesotho: *Ha o nahana, hobaneng lejuba le ile la siya lee la lona la tsamaya?*

Tshivenda: *Mathomoni a tshifanyiso, ndingani mme a zwifhindo vho tutshela tshitaha?*

This question asks, "Why does X do that?". In some sense, it asks about the mother bird's behaviour in the story. It encourages children to think critically about a problem or phenomenon and to generate possible explanations based on their understanding of the world. Furthermore, this question asks children to reflect on the causes or underlying reasons behind a specific event or outcome. This requires them to think beyond the surface level of what they observe and to consider the different factors that may have contributed to the result.

2.7.2 Procedural Explanation

The investigation of procedural knowledge, and its role in the learning process, has been of great interest to many researchers in the field of education and cognitive psychology (Cowan & Renton, 1996; Dixon & Moore, 1996). This literature has highlighted the importance of procedural knowledge in learning and has demonstrated that it is a critical component of cognitive development, allowing individuals to perform tasks and solve problems effectively. Much of these studies in the literature are on the relations between procedural knowledge and other types of knowledge such as conceptual knowledge (Rittle-Johnson & Alibali, 1999). Furthermore, much of these studies focus on the academic domain (Rittle-Johnson & Alibali, 1999). The need for such studies is seen in the fact that learners in schools perform poorly, especially in subjects like mathematics. In this literature, there is an on-going contestation on whether conceptual knowledge precedes procedural knowledge, whether procedural knowledge precedes conceptual knowledge, or whether the relations between the two is not a unidirectional one (Rittle-Johnson & Alibali, 1999; Cowan et al., 1996; Cowan & Renton 1996). The current study notes that this literature provides much information on the matter, however, the relationship between the two does not fall within the scope of this study. The current study will only focus on procedural knowledge.

According to Rittle-Johnson et al., (2001), procedural knowledge is frequently referred to as knowledge of procedures. A procedure is a sequence of steps taken to achieve a specific objective (Rittle-Johnson et al., 2015). This kind of knowledge encourages procedural flexibility, which is the ability to know more than one approach to solve a specific kind of problem and use it in a variety of contexts (Rittle-Johnson, 2017). It has been noted that students that study mathematics in schools possess this kind of knowledge. These investigations proved that school-aged children are capable of following procedures. The

relationship between conceptual knowledge and procedural knowledge was examined by Rittle-Johnson and Alibali (1999) in their study. Participants in this study were fourth and fifth grade students. This study has demonstrated that school-aged children (fourth and fifth graders) have both conceptual and procedural skills. In this study, the authors looked into how instructions on the concepts of mathematical equivalency affects children's problem-solving procedures as well as how instructions on procedures for problem-solving affects children's conceptual understanding of equivalence. The study's findings showed that most children could follow the right procedures in the test, demonstrating that they have procedural skills. The study further demonstrated that when learning a new skill, learners tend to use procedural knowledge first (Rittle-Johnson & Alibali, 1999). This shows that procedural knowledge is important in the early stages of learning a new skill.

The current study observes that the findings of Rittle-Johnson and Alibali (1999) have been echoed by a number of other studies that have explored similar questions and concepts. In terms of procedural explanations, the current study notes that one must have procedural knowledge, skills and understanding in order to generate these explanations. This type of explanation involves describing how something works. It is very specific and is a step-by-step process. As stated, generating explanations facilitates learning. According to Rittle-Johnson (2017), creating explanations to make sense of information is another frequent and effective learning activity. The author went on to say that encouraging students to explain novel concepts, including examples of how to solve arithmetic problems, helps in math learning. Additionally, according to Rittle-Johnson (2017), explanations, particularly self-explanations, support conceptual and procedural knowledge by directing attention to structural features rather than surface features of the content that needs to be learned. This allows students to recognise important structural features of exemplars and come up with procedures that are not dependent on any specific surface features of the exemplars. Rittle-Johnson et al., (2017) conducted a study in which the authors showed that self-explanation prompts encourage stronger procedural knowledge, particularly procedural transfer, as well as improved conceptual knowledge.

The current study sees it vital to investigate children’s procedural explanations. Children who speak the study’s target languages will be questioned in order to elicit a procedural explanation. For instance, an explanation to the question of how a zip functions would be an illustration of a procedural explanation. The individual might describe each phase of a procedure. The

following is a question that will be asked to the participant in order to elicit a procedural explanation from them.

2. How does the egg arrive at Jerry's house (Jerry is the mouse)?

IsiZulu: *Lifike njani lela qanda endlini kaJerry?*

Sesotho: *Lee le fihlile jwang ntlung ya Jerry?*

Tshivenda: *Kumba lo swika ngadilade mudini wa Jerry?*

The question above encourages the participants to explain the specific procedures or steps that are involved in going to Jerry's house. This includes things like the egg rolling from the tree and being trapped on the spider-web. This question prompts a procedural explanation from the participants.

2.7.3 Theory of Mind Explanation

The question of how humans are able to understand and attribute mental states, such as beliefs, desires, and intentions, to themselves and others has been a topic of interest for a long time (Hickling & Wellman, 2001; Wellman & Lagattuta, 2004; Wellman, 2011; amongst others). This continues to be an active area of study under the umbrella of "theory of mind" research. The ability to understand and ascribe mental states to others is a fundamental aspect of human cognition, and it allows us to make sense of each other's actions and behaviour (Wellman, 2011). We constantly interpret the actions of others in terms of their underlying motivations and mental states, which enable us to engage in social interactions and relationships.

Research has demonstrated that not only do children seek explanations for the behaviour and motivation of others, but they are also capable of providing their own explanations for these phenomena (Hickling & Wellman, 2001). This shows that children have the ability to think critically and make sense of the world around them, even at a young age. They are not just passive observers, but active participants in their own learning and understanding. Recent research has demonstrated that children have the ability to provide psychological explanations, and these explanations reveal that there is a development of theories of mind (Wellman & Lagattuta, 2004). As explained above, the theory of mind refers to the everyday understanding of how people are perceived in terms of their internal psychological states (Wellman & Lagattuta, 2004). These authors further argued that this implies that our understanding of

people is mostly intuitive. This means that people typically think of each other in terms of their desires, mental beliefs, emotions, and goals (Wellman & Lagattuta, 2004).

Flavell and Miller (1998) argued that children gradually develop the ability to understand people's thoughts and feelings, and this understanding is demonstrated when they are able to communicate what another person is thinking or feeling. In other words, theory of mind is shown when children can accurately describe the mental states of others, such as their intentions, desires, or beliefs. Peterson and Riggs (1999) observed that the theory of mind competency in children develops around the age of 4 years. Furthermore, it is also observed in the literature that theory of mind can be accounted for by, at least partially, counterfactual reasoning (Riggs et al., 1998; Perner, 2000; Guajardo & Turley-Ames, 2004). In their study, Guajardo and Turley-Ames (2004) examined the relationship between theory of mind and counterfactual thinking in children by employing antecedent and consequent counterfactual tasks. Additionally, the study delved into children's proficiency in producing various types of counterfactual statements, such as antecedent-oriented and consequence-oriented statements, as well as considering their linguistic structure. Counterfactual thinking refers to the understanding of events that are "counter to reality" (Riggs et al., 1998; Guajardo & Turley-Ames, 2004). As mentioned above, children demonstrate an understanding of false belief, the cornerstone of theory of mind development, around the age of 4 years. Guajardo & Turley-Ames, 2004 included 3-, 4-, and 5-year-olds in their study, hypothesizing that counterfactual and theory of mind thinking performances will improve across the preschool period. The researchers found that counterfactual thinking was related to false understanding, which is a key aspect of theory of mind development. Specifically, the study found that children who were better at generating counterfactuals were also better at understanding the thoughts and beliefs of others (Guajardo & Turley-Ames, 2004). The researchers suggest that this may be because counterfactual thinking requires children to consider multiple possibilities and outcomes, which is similar to the cognitive processes involved in understanding the beliefs and perspectives of others.

In the present study, the following question will be asked in order to elicit theory of mind explanation from the participants.

3. Why is the baby bird happy to see Jerry?

IsiZulu: *Kungani ingane yenyoni ijabule ukubona uJerry?*

Sesotho: *Hobaneng nonyana ne e thabile ho bona Jerry?*

Tshivenda: *Ndingani fhondo lo takala li tshivona Jerry?*

The above question aims to elicit a theory of mind explanation from the participants. It requires them to consider the baby's thoughts and emotions, and to make inferences about why the baby bird is happy to see Jerry. It prompts the participants to think about the baby bird's mental states, such as its emotions and desires, and to try to understand their motivations. In some sense, this question aims to help the participant to better understand the emotions and motivations of others, and to develop their ability to put themselves in another person's shoes, which is an important aspect of theory of mind development.

2.7.4 Causal Explanation

Since Piaget's (1929) work on child development, scholars have been fascinated by the ways in which children learn to reason about cause and effect. Many studies since then have demonstrated that children are capable of understanding and applying general principles of causality in various contexts, from physical science to social interactions (Wellman & Gelman, 1998; Kushnir & Gopnik, 2005; and others). These studies have provided important insights into the development of children's causal reasoning abilities and have shed light on the cognitive processes involved in understanding causality. While the existing body of research has provided valuable insights into the development of causal reasoning, the lack of studies on Bantu-speaking children suggests that there is still much to be learned about the ways in which children from different cultural and linguistic backgrounds make sense of cause and effect.

Causal explanations play an important role in everyday reasoning (Hickling & Wellman, 2001). This is a type of explanation that seeks to identify the causes or underlying reasons for a particular event, outcome, or phenomenon. It attempts to answer the question "Why did X happen?" by identifying the factors or events that led to the outcome. Legare and Clegg (2014) suggested that when people create causal explanations, they do so with specific purpose or goal in mind, and they tend to focus on the aspects of the situation that are most relevant or important to them. From this perspective, one might state that generating an explanation might demonstrate one's perspective of the world. Research has, furthermore, demonstrated that the ability to generate causal explanations increases with age.

According to Legare and Clegg's (2014) argument, children employ causal explanatory understanding to explain both consistent and inconsistent events. The authors argued that

children have a prior knowledge and when things occur as they anticipated based on their prior knowledge, they make use of their causal explanatory understanding to explain this consistent event. However, when something does not occur as anticipated based on their prior knowledge, they employ their causal explanatory understating to explain this inconsistent event (Legare & Clegg, 2014). Legare et al., (2016) demonstrated this in their study. The authors investigated the events that led children to revise their explanations. Since literature claims that explanations help in the acquisition of new information and the construction of new understanding, the authors argued that children should be able to generate explanations from observations that can teach them something new (Legare et al., 2016). In this study, the authors examined the causal explanations of children for inconsistent outcomes and if children will be able revise these explanations when faced with new evidence. They were interested in finding out if children will be able to incorporate this new information from within and across different domains into existing explanations (Legare et al., 2016). This study shows that events that are inconsistent with prior knowledge trigger children to make use of their causal explanatory understanding, and events that are consistent with prior knowledge are less likely to trigger children to generate explanations (Legare et al., 2016).

In the current study, children will be asked the question below in order to elicit causal explanations from them.

4. Why did Jerry take the baby bird back to the nest?

IsiZulu: *Kungani uJerry embuyisela esidlekeni?*

Sesotho: *Hobaneng Jerry a ile a kgutlisetsa nonyana ko hodimo ha sefate?*

TshiVenda: *Ndingani Jerry a humisela ḓhondo tshitahani?*

This question encourages children to think about the underlying reasons or causes for Jerry's behaviour in the cartoon. It is a "Why did X happen?" question that attempts to make children engage in causal reasoning. It invites children to consider the factors that might have influenced Jerry's actions such as motivations. Furthermore, it encourages children to think critically about the causes and effects of different events or behaviours happening in the cartoon.

2.8 Gesture

A gesture is any bodily movement that has meaning. Gestures are the spontaneous movements that people make when they speak. Usually, these are movements of the arms and hands that

are tightly timed to the speech. Kendon (1983) extrapolates this definition by arguing that gesture is separate from emotional expression and does not include “nervous movements”, mannerism, or various minor tics. According to Kendon (2004), the term "gesture" often does not include involuntary or unintended body expressions, such as those that are seen as unavoidable reactions to ideas or emotions. Rather, the phrase is only used to describe deliberate, purposeful body motions used to convey particular concepts or meanings. In this sense, gestures are viewed of as a way to communicate ideas or feelings to other people. It encompasses movements such as waving, thumbing the nose, or beckoning. These are involuntary pantomimes someone may use to express themselves when at a loss for words. Kendon (1983) further states that gesture is the waving of arms and vigorous head movements when someone talks. Gestures can provide important details about a speaker's cognitive processes, just as words can reveal a speaker's thoughts (Goldin-Meadow, 2002). According to McNeill (1992), considering the speaker's gesture enables us to see them not only as a speaking individual but also as a holistic being, with their acting, willing, thinking, and feeling all interconnected components of who they are as a whole. This way, listeners are able to understand the meaning that a person is trying to convey by looking at the full person rather than simply their voice or gestures alone.

Gestures are symbols with distinct meanings and messages that go beyond simple arm waving or spontaneous movements. According to McNeill (1992), gestures are more than just physical acts; they also convey certain meanings that the speaker intends and chooses. According to McNeill (1992), a hand can symbolise a wide range of concepts when it is used as a gesture, including the hand of a character, the character, an object, or even a location. The speaker can express a variety of meanings that come from their thoughts and ideas because to the flexibility and creativity of their gestures. McNeill (1992) adds that although they coexist in conversation alongside words and sentences, gestures and words have simply different meanings. A significant portion of the evidence supporting the idea that gestures are symbols comes from analysing the gestures made by several individuals when narrating the same event. Much of this stems from the communicative intent research – narratives (Kunene Nicolas 2010, 2015; Colletta, 2004; Colletta et al., 2009, 2015; amongst others). These studies demonstrate that speech and gesture coexist as two linked symbol systems.

2.8.1 Classification of Gestures

Several classifications of gestures have been proposed by scholars to distinguish between them (Kendon, 1988; McNeill, 1992, 2000). These divisions may be based on functional or semiotic characteristics, or perhaps on a combination of the two (Tellier, 2010). Kendon's continuum is an extremely effective classification. Based on Kendon's work (1988), McNeill (1992) elaborated Kendon's continuum.

Gesticulation ➔ Language-like-gestures ➔ Pantomimes ➔ Emblems ➔ Sign Language

Gesticulations are bodily movements that accompany speech. Though they are not limited to these body parts, these are the most common gestures produced with the arms and hands. If the hands are engaged or immobilised, the head may occasionally take over. An example of this gesture is when hands make a round shape when the speaker says, “there was a ball”. Gesticulation almost never occurs in the absence of speech (McNeill, 1992). Language-like gestures resemble gesticulation in shape and appearance, but they are different in that the utterance they are part of is grammatically integrated (McNeill, 1992). They are included in the sentence. An example of this is when some says, “look on your [gesture]”. The gesture fills the slot where someone should look, maybe on their right or left. Pantomimes are bodily movements where hands depict object or actions, but speech is not compulsory. Emblems are conventionalized signs which are specific to a specific community or society. Like with pantomimes, speech is not compulsory with emblems. McNeill (1992) states that emblems have a standard of well-formedness and this standard must be met when making an emblem sign. For instance, an OK sign is made with the thumb finger up and other fingers down. This is understood as OK in different communities and societies. However, if both the thumb and index fingers are up, this would no longer be an OK sign. Lastly, sign language such as SASL is a fully-fledged linguistics system that incorporates all the essential components of a complete language, including segmentation, compositionality, lexical vocabulary, syntax, arbitrary signs, well-defined and appropriate signs, and a community of fluent users (McNeill, 1992).

Many studies focus on the co-speech gestures or gesticulation in Kendon’s continuum (Kunene Nicolas 2010, 2015; Alamillo et al., 2013; Colletta et al., 2015; amongst others). As stated, these are bodily movements that accompany speech. Inspired by this and Kendon’s continuum in general, McNeill (1992) proposed a classification scheme with four categories: *iconic, metaphoric, deictic*, and *beat*. They all fall under gesticulation (co-speech gestures) on

Kendon's continuum. A gesture is *iconic* if it has a formal connection to the semantic meaning of speech (McNeill, 1992). The author further states that these gestures illustrate elements of the same situation that speech does as well. For instance, someone might say, "he caught the tennis ball with his right hand", and gesture with his right hand as if grabbing something. This gesture depicts a feature also referred to in speech, namely, grabbing or catching something.

Metaphoric gestures are similar to iconic except that they show abstract concepts rather than concrete objects (McNeill, 1992). In a metaphoric gesture, an abstract meaning is presented as if it had shape and/or occupied space. For example, one might gesture downward to indicate low intelligence. A deictic gesture is a kind of pointing motion that can be used to indicate concrete or abstract objects. It can be executed with the hand, finger, or chin, among other body parts. Pointing at a person, thing, or place is one example of a concrete deictic gesture. Another is pointing to a table and saying, "The ball is on that table". *Deictic* gestures, on the other hand, can also be abstract and refer to an occult individual, location, or instant in time (Tellier, 2010). For instance, pointing backward may be interpreted as the past. *Beat* gestures are rhythmic movements that have no semantic relationship to the speech they accompany. McNeill (1992) states that these gestures are hand movements that rhythmically move up and down or back and forth, synchronising with the most stressed portions of speech also referred to as "prosodic peaks." The speaker uses these gestures as a kind of punctuation to indicate the point in time at which they believe something is important to the message's wider context (McNeill, 1992).

2.8.2 Theories of Gesture

The relationship between gesture and speech remains a contentious issue, with ongoing debate in the academic community regarding their interconnectivity. While gesture undoubtedly plays an important role in human communication, its functions extend beyond supporting verbal communication. Gestures have diverse origins and serve multiple purposes (Krauss et al., 2000). The literature offers diverse models that attempt to provide explanations for gesture occurrence, each with its own unique perspective on the interplay between language, cognition, and gesture. One of these models argues that the primary function of gesture is for communication, and another model asserts that, during speech production, gestures facilitate cognitive processes. Additionally, there are theories and hypotheses that offer different co-speech gesture frameworks.

The Lexical Retrieval Hypothesis posits that gestures aid in the retrieval of words during speech production (Krauss et al., 2000). This hypothesis posits that gesture eases speech

production, and gesture aids individuals find right words in speech. In essence, they assist individuals in locating the appropriate words to express their thoughts. Supporting this hypothesis, Rauscher et al. (1996) argued that when speakers are prevented from gesturing, their speech becomes disfluent owing to difficulties in word retrieval. This suggests that gestures serve an important role in language production, facilitating the speaker's ability to find and produce the appropriate words in a fluent manner. To test this, the authors used an animated cartoon as a stimulus to examine the results that occur when speakers are prevented from gesturing. Their results demonstrated that while describing spatial aspects of the cartoon, speakers became disfluent when gesturing, indicating a potential disconnect between the spatial and linguistic systems in this context. Conversely, when describing non-spatial aspects of the cartoon while gesturing, speakers were found to be fluent (Rauscher et al., 1996). These findings suggest that the relationship between gesture and speech fluency may vary depending on the specific linguistic or conceptual content being described, highlighting the multifaceted role of gesture in language production.

The Interface Hypothesis offers a novel perspective on the relationship between gesture and language production, asserting that gestures derive from the depiction of the spatio-motoric interface between spatial thinking and speaking. This hypothesis diverges from the Lexical Retrieval Hypothesis, proposing that gestures may encode information about spatio-motoric properties not expressed verbally. Kita and Özyürek (2003) contend that gestures emerge from the representation of the spatio-motoric interface between spatial thinking and speaking, supporting the Interface Hypothesis. The authors further postulate that gestures encode non-linguistic spatio-motoric properties of the referent and assist in structuring information about the referent in a manner that is compatible with linguistic encoding possibilities. This hypothesis highlights the importance of the interface between spatial thinking and speaking, suggesting that gestures serve a vital role in organizing and encoding information, particularly in the realm of spatio-motoric aspects, which may not be easily or directly expressed through verbal means alone.

In a comparative study, Kita and Özyürek (2003) examined three distinct languages - Japanese, American English, and Turkish – by analysing gestures produced in narratives that were elicited using the same stimulus. These languages exhibit notable grammatical differences, particularly in their capacity to encode agentive changes in location. The absence of such an expression in Japanese and Turkish, as opposed to its presence in English, suggests that

speakers of the former languages may rely more heavily on gestural communication to convey this information. Consequently, the Interface Hypothesis predicts that Japanese and Turkish speakers will employ the arc trajectory gesture in the stimulus scene more frequently than their English-speaking counterparts. Kita and Özyürek (2003) state, in their findings, that there is a linguistic effect on the depiction of gestures.

2.9 Chapter Summary

This chapter outlined the general overview of Bantu languages and narrowed this to only three Bantu languages that are of interest in this study - isiZulu, Sesotho, and Tshivenda. It further highlighted the general overview of late language acquisition with the emphasis that language acquisition has no point of completion. It is a long-term journey that children embark on. The literature on explanation in children was lengthily discussed in this chapter with the focus on four types of explanations - Hypothesis Formulation, Procedural, Theory of Mind, and Causal explanations. Lastly, the chapter discussed the relationship between speech and gesture. This literature sheds light on the current study as it tries to understand how children conceptualise explanations and if co-speech gestures facilitate explanations. The chapter that follows discusses the methodology that is used to conduct the current study.

Chapter 3 – Methodology

3.1 Introduction

The study aims to examine the development of explanatory abilities in South African Bantu languages. It aims to investigate how explanations are produced by speakers of isiZulu, Sesotho, and Tshivenda who are between the ages of 5–6 years and 9–10 years from a multimodal perspective. This chapter discusses the methodology used in analysing the nature of the research data. The study employs the methodology used in the "ANR Multimodality" research project (Colletta et al., 2015; Kunene Nicolas 2010, 2015; Colletta et al., 2009, 2010). This method employs a language production task that elicits oral explanations in children. It is part of other studies that used it to employ a language production task that elicit oral narratives (Kunene Nicolas 2010, 2015; Alamillo et al., 2013; Colletta et al., 2009, 2010). The study uses a cartoon extract, allowing the researchers to map out variations that occur between the participants' explanation skills and the languages that are of interest in this study. Additionally, this allows the researchers to map out the type of gestures that participants use when producing their oral explanations.

3.2 Overview of the archival data

The methodology for this study is directly linked to a larger project that is originally incepted by "ANR Multimodality" (Colletta et al., 2015). This project investigated the development of oral narratives in speakers of French, Italian, and American English. Their findings revealed that narrative ability develops with age. Process of data collection in this study followed the same data collection process in Colletta et al., (2015), Kunene Nicolas (2015), Alamillo et al., (2013), and Colletta and Pellenq (2009). This study seeks to utilise existing data for a novel purpose; that is, to investigate explanatory skills from a multimodal perspective. The data was obtained, coded and anonymised. This study will be an opportunity to work with and further annotate the existing data, bringing it in line with the current research questions.

Participants were shown a wordless cartoon stimulus. The cartoon is a Tom and Jerry short clip (about 2 min 43 sec). It is about a mouse (Jerry) and a woodpecker. The story starts with the mother bird leaving her nest with an egg in it. The egg accidentally falls out of its nest and rolls into Jerry's (mouse) house. While in Jerry's house, the egg starts to hatch, and a woodpecker emerges. The baby woodpecker starts damaging Jerry's furniture, and when Jerry failed to calm it down, he angrily decided to return it to its nest. When the participants finished watching this

cartoon, the interviewer asked questions related to the cartoon. These were “Why” and “How” questions, aiming to elicit explanations from them.

The task was filmed with a camcorder. The video camera that was used was a Sony HDR-CX190E Digital HD Video Camera Recorder. It was placed in a position that focused on capturing the participant’s body from the knees to the head. Participants watched the cartoon and were filmed individually. When analysing the collected data, the ELAN software was used.

3.3 Quantitative Data

To analyse the explanatory discourse of children in this study, a quantitative research approach was utilised. Quantitative methods involve collecting and analysing data in numerical form to gain a deeper understanding of a particular issue or phenomenon. In accordance with Aliaga and Gunderson (2000), quantitative research methods use mathematical techniques to generate objective, numerical results that shed light on the relationship between various variables of interest. Expatiating on this definition, Rahman (2016) states that a quantitative approach focuses on evaluating something or variable that occur in the social world. Rahman (2016) further states that the quantitative approach focuses on social behaviour components that can be measured and organised rather than discovering them and interpreting their meaning. By analysing the relationship between the variables, the quantitative approach focuses on testing out objective theories (Creswell, 2014). It aims to refute or support these objective theories. Drawing on the work of scholars such as Williams (2011), we observe that quantitative research typically begins with the formulation of a research problem and the development of hypotheses or research questions. This is followed by a review of existing literature on the topic of interest and finally, the quantitative analysis of gathered data. In the context of this study, the central research problem concerns the development of explanatory abilities in children speaking South African Bantu languages during the stage of late language acquisition.

3.4 Variables

As mentioned above, this study makes use of the quantitative approach, and this evaluates variables. According to the Fraser Health Authority (2011), a variable is a trait or characteristic that varies in terms of quality and quantity in things and people. Scholars such as Apuke (2017) assert that a variable is not only quantifiable but also manipulable and controllable. It can be independent and dependent. An independent variable is a variable that can be manipulated during an experiment in order to see how it affects a dependent variable. A dependent variable

is a variable that is dependent on an independent variable(s) (Apuke, 2017). Table 1 shows variables that will be looked at in this study.

Table 1: Variables

Dependent Variables	**Independent Variables**
Clauses	Language
Pragmatic Acts	Age
Clauses per explanation type	
Response Accuracy	
Gesture	

3.5 Participants

This study used a random sampling method. This is a process for choosing participants in quantitative research (Creswell, 2014). Participants are school aged children between the ages of 5–6 years and 9–10 years. They were randomly selected in their schools where the languages are taught, and they are native speakers of that language. As stated, the selection of these participants was random, meaning that every learner in that school being a native speaker of the language had an equal opportunity to participate in this study. The selection process was entirely based on luck.

For the purpose of this study, three groups are targeted. These groups comprise native speakers of isiZulu, Sesotho, and Tshivenda respectively. It looked at two age groups, 5–6-year olds and 9–10 year olds. These age ranges indicate several stages of development; hence they were chosen. Furthermore, this study looks at three Bantu languages because it intends to make an intra-linguistics comparison of whether explanatory abilities are language specific or language universal. Table 2 shows the number of participants that were involved in this study.

Table 2: Number of participants

Age Groups	**Number of participants**		
	IsiZulu	**Sesotho**	**Tshivenda**
Group 1 (5–6-year olds)	10	10	10
Group 2 (9–10-year-olds)	10	10	10
Total Number of participants	60		

3.6 Stimuli

As previously mentioned, the study is directly linked to a larger project (Colletta et al., 2015) and employs existing data. The stimulus that was used in this study was a wordless *Tom and Jerry* cartoon. This short video was shown to children, and they were asked questions related to it. The following questions were asked to children. Their explanations were videotaped and subsequently analysed.

1. In the beginning of the cartoon, why does the mother bird leave the nest?
2. How does the egg arrive at Jerry's house (Jerry is the mouse)?
3. Why is the baby bird happy to see Jerry?
4. Why does Jerry take him back to the nest?

These four specific questions were formulated to elicit four distinct types of explanations: Hypothesis Formulation, Procedural, Theory of Mind, and Causal explanation types. The objective of the first question was to gauge the children capacity to produce hypothetical scenarios, while the second question aimed to assess their ability to explain a procedure or step-by-step process. The third question evaluated their understanding of mental states in others, and the final question sought to determine their comprehension of causal relationships. A typical interaction with a 10-year-old Tshivenda-speaking child in the explanatory task is provided below (*for isiZulu and Sesotho, see Appendix C).*

Adult: Mathomoni thomoni kha nganeapfufhi heilani, ro sumbedziwa mathomoni mia tshinoni a tshi bva tshitahani, ndi nga mini?

'In the beginning of the cartoon, we were shown the mother bird leaving the nest, why did she leave the nest?'

Child: *Vha vha tshi khoyo toda zwiliwa*

"She went to look for food."

Adult: *Lo swikisa hani kumba liya fhala mudini wa Jerry?*

"How did the egg get into Jerry's house?"

Child: *Lo vha li kho tshimbila li kho soko mona hafhala ntha ha tshitaha, la mbo di wa la wela maluvhani la kunguluwa la kunguluwa la swika la gogonya vothi la vulea la dzhena la ya la edela na Tom.*

"The egg was roaming around on top of the nest, then it fell on top of the flowers… It rolled and rolled and then it banged the door, the door opened the egg went in and went to sleep with Tom.

Adult: *O vha o to dala madakalo nwana wa tshinoni musi a tshi vhona Jerry, ndi nga mini? Ndi nga mini mwana o la wa tshinoni a tshi tou bona Jerry a dala madakalo?*

"The baby bird was so happy when it saw Jerry, why was it? Why was it so happy when it saw Jerry?"

Child: *Ngori o wana o edela*

"It is because it found it (Jerry) sleeping."

Adult: *Ndi nga mini Jerry a tshi dzhia ula nwana wa tshinoni a tshi humisela ngei tshitahani tshatsho?*

"Why did Jerry take the baby bird back to the nest?"

Child: *O vha a tshi kho silinga*

"It is because it was troublesome."

The explanatory task was performed after the narrative task. This means that when children were asked to provide explanations, they had already made an effort to organise and recall the events from the cartoon in a narrative.

3.7 Transcription and Coding

All video recordings of the data were secured in a password-protected computer. These videos were converted to be compatible with the *ELAN* software, and they were coded and annotated using this software. *ELAN* is a language annotation programme that employs a multi-tiered coding network to enable annotation of both participants' gestures and speech. Annotations for video and audio data can be created, edited, visualised, and searched using this tool. It was created especially for the study of language, sign language, and gesture (http://www.mpi.nl/tools/, 2012).

Transcription included the coding of both speech and gesture of the participants. The coding manual that was specifically designed by Colletta et al., (2009, 2015) was used in this study to annotate the data. This annotation scheme was used to annotate speech turns, explanation clauses, type of explanations and co-speech gestures. Each of these annotations was coded on different tiers. In this software, only the interviewer's speech and each participant's hands and head movements, as well as speech, was recorded.

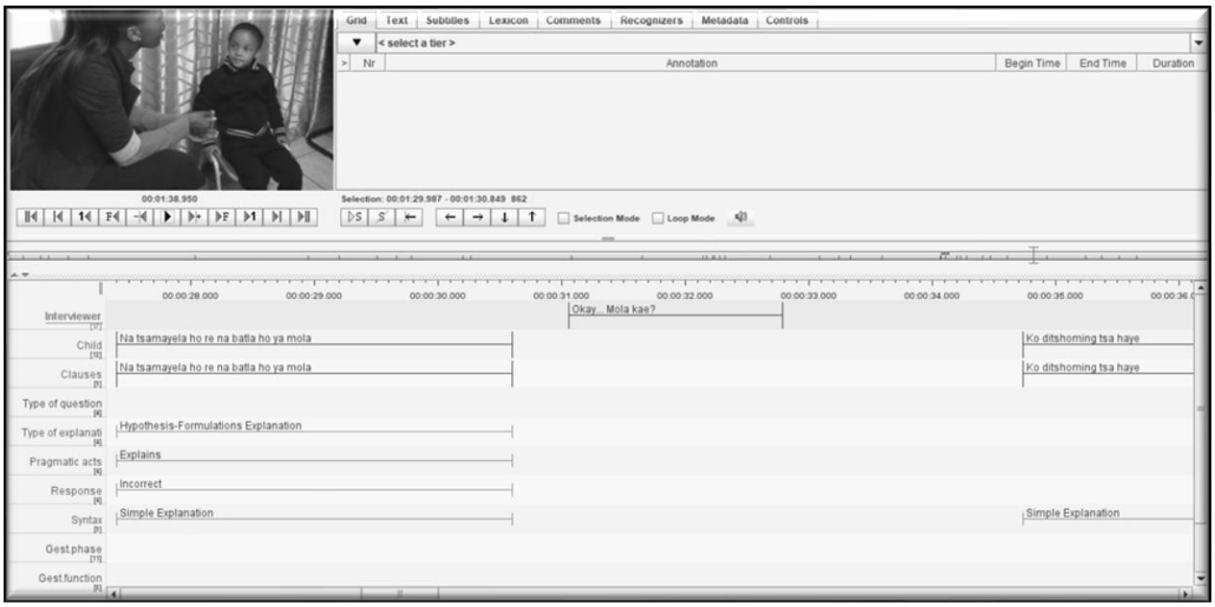


Figure 3: Image of annotation file on ELAN

3.7 Speech Analysis

In the software, both the speech of the interviewer and the participant were orthographically transcribed. This transcription was the exact replication of what the interviewer and the participant had said in their speech (questions and explanations). Each word, pause, repetition, hesitation, and any errors made by the interviewer and participant were all included in the transcriptions. The interviewer's speech was included in the grid so that we could be able to track whether the child (participant) was able to give the correct explanation to the question asked by the interviewer. Both the interviewer and the participant had different transcription grids on the software. The interviewer's transcription grid was followed by the participant's transcription grid. First, we transcribed the speech of interviewer in their language (isiZulu, Sesotho, or Tshivenda). The English translation tier followed after this. Only the speech of the interviewer was translated.

The type of question tier followed the English translation tier. In this tier, the focus was on the interviewer's speech. This enabled us to track the questions that the interviewer was asking the participants. These questions aimed to elicit (1) Hypothesis Formulation explanation, (2) Procedural explanation, (3) Theory of Mind explanation, and (4) Causal explanation from the participants. These questions were asked in the mother tongue of the participants. For instance, Sesotho speakers were asked the following questions in their language.

1. *Hoqaleng ha dipopaye, hobaneng lejuba le ile la siya lee la lona la tsamaya?*
2. *Lee le fihlile jwang ntlung ya Jerry?*
3. *Hobaneng nonyana ne e thabile ho bona Jerry?*
4. *Hobaneng Jerry a ile a kgutlisetsa nonyana ko hodimo ha sefate?*

Following this tier, speech of the participant was transcribed. This was then followed by the segmentation of speech into clauses. In this tier, only the participant's speech was segmented into clauses. This means that the oral transcriptions of the participant were classified into clauses. A clause can be defined as a group of words that includes a verb and one or more satellites that serve as the verb's subject and complement (Colletta et al., 2009; Kunene Nicolas 2010). From this definition, we note that the pauses, hesitations, repetitions, and any errors that were annotated in the participant's transcription grid are now removed. They are not included in the clause annotation tier.

The following examples from isiZulu and English demonstrate how clauses are coded (Kunene Nicolas 2010, p.30).

a. *Iqanda lagxhuma, lawela olwembini*.

"The egg jumps, it falls into the spider web."

This sentence contains two predicates and was, therefore, coded as having two clauses – "*gxhum"* (root for jumps) and "*wa*" (verb root for falls).

b. "It was caught by the spider web".

This sentence contains only one predicate, and it was, therefore, coded as having one clause.

The following examples from five-year-old participants in the three languages were considered as single clauses.

c. *Ngoba liwile* – isiZulu

"Because it fell."

d. "*Hobene ya motena*" – Sesotho

"Because it was annoying."

e. "*Ngauri o vha akho bora.*" -Tshivenda

"Because it was boring."

The tier that followed was the English translation of the participant's speech. This only translated the speech that was segmented into clauses. The type of explanation tier followed the English translation tier. This tier only focused on the participant. It aimed at tracking the type of explanation that the participant produced in response to the type of question asked by the interviewer. In the first question, the participants had to produce a Hypothesis Formulation explanation. In the second question, the participants had to produce a Procedural explanation, and in the third question, they had to produce a Theory of Mind explanation. In the last question, the participants had to produce a Causal explanation. Table 3 shows these types of explanations.

Table 3: Types of explanations

Type of explanations	**Description of the explanation**
Hypothesis Formulation Explanation	Participant provided was a hypothesis-formulation explanation only
Procedural Explanation	Participant provided was a procedural explanation only.
Theory of Mind Explanation	Participant provided a Theory of Mind explanation only
Causal Explanation	Participant provided a casual explanation only

The types of explanations tier was followed by the pragmatic acts. This focused on the identification and categorisation of linguistic clauses as expressing speech acts (Colletta et al., 2009). In recounting of the cartoon, a distinction was made between the following categories:

1. **Narrating**: The participant narrates the events of the story as it happened in the cartoon (e.g., "a baby woodpecker emerged from the egg")
2. **Explaining**: The participant enhances the narrated event with specific details on its cause (e.g., "Jerry takes it back to the nest because it was damaging his furniture").
3. **Interpreting**: The participant offers an inference or interpretation about the circumstances or the characters' motivations (e.g., "It looked at the time and realized that it was time to fetch food").
4. **Commenting**: The information provided by the participant is not apparent from the events that are in the narrative. The information provided could be in the form of para-narrative remarks related to the speaker's act of narrating, such as their opinion, assessment, or personal appreciation of the story, or meta-narrative remarks that offer the speaker's perspective on a character, plot element, or any other aspect of the story (e.g., "It is a crazy bird").

Following the pragmatic acts, the response that the participants produced to the question asked by the interviewer was considered. This sought to examine the type of the response the participant gave in response to the question asked by the interviewer. It is a descriptive tier that describes the performance of the participant on the task. The annotation of this fell for its entire duration within the participant speech turn. All correct responses were coded as 'correct' and

all incorrect responses and responses where the participant did not provide a response or says, 'I don't know' were coded as 'incorrect'. Partial responses that were not entirely correct were coded as 'partial'. Table 4 makes these distinctions.

Table 4: Response Accuracy

Response type	**Detailed description**
Correct response	The participant gives a correct response and is on target.
Incorrect response	The participant was not on target, no response, or participant says, "I don't know" even with only a gesture such as a shrug.
Partial	The participant is not on target, but their response is not far from being correct. For instance, they might say "It was its mother/friend" instead of "it thought it was its mother".

3.8 Gesture Analysis

For the analysis of gesture, only bodily movements that maintained a relation to speech were coded (co-speech gestures). The study pinpointed the gesture units performed by each participant during the explanation production. According to Kendon (2004), a gesture unit is a body movement that starts when the articulators (such as the hands or arms) start to move from a relaxed position and ends when they return to a state of relaxation. The author emphasises that the gesture unit encompasses the entire excursion of movement, including the preparation, stroke, and retraction (or return) phases. These are called gesture phases – they are the component of the gesture unit. When determining whether a movement constituted a gesture unit, the study followed Kendon's (2004) criteria, which included assessing three key factors: movement, location, and configuration. For each of these factors, the study used a 2-point scale to determine whether the movement qualified as a gesture.

- *Movement*: when assessing the movement factor, the coder awarded 2 points if the movement was easily observable and had a significant amplitude and speed. However, if the movement was difficult to perceive, and had a small amplitude and slow speed, it was awarded 0 points. If the movement fell somewhere in between these two extremes, it was given 1 point (Kendon, 2004).

- *Location*: when evaluating the location factor, the coder awarded 2 points if the gesture was performed in a central, front-facing position, where it was easily visible to the listener. However, if the gesture was performed off to the side, and was difficult or impossible for the listener to see, it was awarded 0 points. In cases where the gesture was somewhere in between these two extremes, it was given 1 point (Kendon, 2004).
- *Configuration*: when assessing the configuration factor, the coder awarded 2 points if the hand shape or trajectory of the gesture was clear and precise. If the gesture had an imprecise or ambiguous form or trajectory, it was awarded 0 points. If the gesture fell somewhere in between these two extremes, it was given 1 point (Kendon, 2004).

Briefly, the factors above were calculated on a scale of 0 to 2. The strongest value was 2. For a gesture to be counted as a unit it had to score 3 or more points. Once the gesture was identified, the values below were used to annotate its phases (Kendon, 2004).

1. **The Preparatory Phase (prep.)** – It refers to the initial movement of the hand, where it transitions from its resting position (initial position) to the starting point of the gesture. It sets the stage for the stroking phase. Different to the hand movements, the position of the head, the bust or shoulders is fixed. They are annotated as 'strokes' because they cannot be prepared as hand movements.
2. **The Stroke Phase (stroke)** – This is the central, meaningful portion of the gesture phase. It is the gesture itself, which is a hand gesture, or a movement of the head, shoulders or bust. It is where the gestural movement is executed.
3. **The Returning Phase (return)** – It is the movement which marks the conclusion of the gesture. This rest position may or may not return the body part to its initial position before the preparatory phase.
4. **The Chain Phase (chain)** – This is a movement which represents a continuous movement that carries the hand(s) from the termination point of one gestural stroke to the starting position of a subsequent stroke, bypassing the Returning Phase. This links gesture strokes together.

The Hold Phase (hold) – This occurs when the participant sustains the position of their hand(s) at the conclusion of a gesture, prior to the Returning Phase or the initiation of a chained gesture, or during the Preparatory Phase.

3.8.1 Gesture Functions

Research in the field of multimodal language has illuminated the importance of considering the functional role of gestures when analysing child language behaviour, as age-related changes impact the pragmatic and cohesive usage of facial expressions, gestures, pointing, and representational use (Alamillo, 2013; Colletta et al., 2010). Consequently, all co-speech body movements observed as gestures were classified and described according to their functions in this study. Using the coding manual, we were able to choose between the following gesture functions (Colletta et al., 2009).

- **Deictic –** These are head or hand movements that the participant makes, pointing to anything that is present in the communication setting. The participant might be pointing to him/herself, the interviewer, or something that is present in the physical setting.
- **Representational** – These are hands or facial movements that represent an object or property of an object. This might be a place, an action, a character, or anything. For instance, two hands drawing a form of a container to represent a nest.
- **Performative –** These are gestures that encompass head and facial movements that effectively communicate speech acts or reinforce verbal messages without the use of spoken words. For instance, nodding head for an affirmative response.
- **Framing** – These are gestures that indicate the mental or emotional state of the speaker. For instance, face showing amusement to express the comical side of a situation.
- **Discursive** – Gestures that facilitate the organization and structuring of speech by emphasising specific linguistic units, as well as enhancing discourse cohesion by linking clauses. They assist in accentuating certain words or syllables, often through facial movements such as raising eyebrows.
- **Interactive** – Gestures accompanied by a gaze towards an interviewer to express that the speaker requires or verifies his attention. For instance, rapid hand or head movement, including gaze towards the interviewer in a quest for his attention.
- **Word searching** – Hand or facial which indicate that the speaker is searching for a word or an expression. For instance, frowning or staring above while searching for words.

3.8.2 Semantic Relations

After classifying and identifying gestures according to their functions, we then provided the definition of the relation of the gesture to the corresponding speech. This involved defining the relationship the gesture has with the corresponding speech. For instance, deictic gesture can either reinforce the speech act or complement it. Representational gestures, on the other hand, integrate, substitute, or supplement speech acts. Discursive gestures reinforce, integrate, or supplement the corresponding speech act. Interactive gestures only supplement the corresponding speech while performative gestures can contradict, supplement, or reinforce the corresponding speech act. On the other hand, word search gestures only substitute the corresponding speech act. Framing gestures normally contradict and supplement the corresponding speech act. The following provides a detailed description of the gesture-speech combinations identified (Colletta et al., 2009).

- **Reinforcement** – Information brought by the gesture is identical to the linguistic information it is in relation with. For instance, head nodding accompanied by an affirmative "yes" or a shrug accompanied by "I do not know". This does not apply to representational gestures because the information brought by the gesture always says more than the linguistic information.

- **Complements** – Information brought by the gesture provides a necessary complement to the incomplete linguistic information provided by the verbal message: the gesture disambiguates the message. For instance, pointing gestures that accompany a location adverb, such as "here" and "there". This only concerns to deictic gestures.

- **Integration** – Information brought by the gesture does not add any supplementary information to the encoded linguistic information but makes it more specific. For instance, an example of this is saying "she leaves" while making a leftward movement of the left hand to indicate the direction of her movement.

- **Contradiction** – The information provided by the gesture was not only different from the linguistic information but also contradicted it. This only concerns framing and performative gestures. However, there can also be a case where a representational gesture might be included. For instance, the speaker might mention three objects in her speech but might produce a gesture that represents number "two".

- **Substitution** – Information brought by the gesture replaces linguistic information. For instance, nodding in an affirmative response or head shaking as a "no" answer.
- **Supplementary** – The information brought by the gesture new information that is not encoded verbally. For instance, this might concern framing gesture where the participant expresses the comical side in the cartoon. This might also concern performative gestures where the participant shakes their head vigorously accompanying a "no" answer.

3.8.3 Temporal placement of gesture

The fourth stage of the gesture analysis involved identifying the temporal placement of the gesture in relation to the corresponding speech. There are three temporal placements which a gesture may be classified under: synchronous, anticipates, and follows (Colletta et al., 2009).

- **Synchronous** - This is when the stroke of the gesture begins at the same time as the corresponding speech. This may be a syllable or a word.
- **Anticipates** - This is when the stroke begins before the corresponding speech. The speaker makes a gesture, and the linguistic information comes after.
- **Follows** - The stroke comes after the linguistic information. The speaker makes a corresponding speech and then makes a stroke after.

3.9 SPSS Software

After the transcription and coding of data on the *ELAN* software, the data was further statistically analysed on the SPSS software. This software is a user-friendly program that offers a wide range of features, including data preparation, management, and visualisation; descriptive and inferential procedures like t-tests, ANOVA, linear and ordinal regression, contingency and correlation analysis; multivariate techniques such as factor analysis, cluster analysis, and discriminant analysis; and non-parametric tests (Frey, 2017). To statistically analyse the data, a non-parametric inferential was used. Ostertagova et al., (2014) states that a non-parametric inferential do not make any assumptions about the parameters of the data, such as the mean or variance. This makes them less sensitive to the specific characteristics of the data. Parametric tests, like ANOVA, assume that the data is normally distributed. Non-parametric tests, such as Kruskal-Wallis and Mann-Whitney, do not make this assumption, and are therefore more robust to non-normal data.

3.9.1 Kruskal-Wallis Test

The Kruskal-Wallis test is a powerful non-parametric statistical tool used for determining whether or not samples come from the same distribution, particularly in situations involving more than two independent samples. Although this test does not require the assumption of normality, it assumes that the samples are independent, randomly selected, and derived from populations exhibiting similar distribution shapes (Ostertagova et al., 2014). While the Kruskal-Wallis test can identify significant differences between the groups, it does not provide information regarding the specific nature or extent of these differences. In order to gain a more detailed understanding of the differences identified by the Kruskal-Wallis test, a subsequent pair-wise comparison procedure is necessary (Ostertagova et al., 2014). This allows researchers to evaluate the significance of the differences between each pair of groups, thereby providing a more nuanced understanding of the observed differences between the samples under investigation. In our study, the Kruskal-Wallis test is a suitable statistical tool for the first research question, allowing the comparison of the explanatory performances among the three language groups without assuming normal distribution. Since the Kruskal-Wallis test does not identify where the differences occur or how many differences occur, we will consider a pair-wise comparison. A post-hoc comparison using Kruskal-Wallis method with a Bonferroni correction for multiple tests was considered. This enabled the identification of where and how many significant differences exist between the language groups.

3.9.2 Mann-Whitney Test

The Mann-Whitney test, a robust non-parametric statistical method, provides a valuable means of comparing two independent groups without requiring assumptions of normality, equal variance, or other parametric conditions (Nachar, 2008). This test operates under the assumption that the distributions of the two groups are homogeneous and independent and is primarily used to determine if there are significant differences between the groups. Like the Kruskal-Wallis test, the utility of the Mann-Whitney test lies in its flexibility, allowing for comparison between groups even when the data distribution is unknown or fails to adhere to the strict assumptions of parametric tests such as normality or equal variance (Ostertagova et al., 2014). In this study, the Mann-Whitney test is a suitable statistical tool for the second research question, allowing the explanatory performance among the two age groups (5–6 years old and 9–10 years old).

3.10 Ethics Considerations

Participation in the study occurred once ethics clearance was granted from the ethics board of the University of the Witwatersrand. As this study uses archival data, ethical clearance was already obtained under the protocol numbers (H14/06/16, H14/06/32, and H13/08/29). For the purpose of this study, an ethics waiver was requested and granted by the Wits School Ethics Committee (HRECNMW24/04/03) (see Appendix B).

3.11 Chapter Summary

The chapter has outlined the methodology that will be used in this study. It revisits archival data that was coded and anonymized. For the purpose of this study, a new annotation framework that is tailored to the current research question was applied. The research adopts a quantitative method. This method deals with quantifying and analysing variables in order to get results. To transcribe and code speech and gesture in all the video recordings, ELAN software was used. This is a multi-tiered coding tool that enables annotation of both participants' gestures and speech. From this software, the data will be exported to Excel and SPSS for a quantitative analysis. In the SPSS software, non-parametric tests (Kruskal-Wallis and Mann-Whitney tests) will be used to test for statistical differences. Lastly, ethics considerations were explained in this chapter. The subsequent chapter outlines the results and findings of the study.

Chapter 4 – Results and Analysis

This study investigates the development of explanatory abilities during late language acquisition in South African Bantu languages – isiZulu, Sesotho, and Tshivenda. It is a multimodal study that encompasses both verbal and co-speech gestures. This study only selected participants who had completed the task. A total number of 60 participants' explanations were compared and contrasted across the three languages and two age groups to access speech and gestural development during the production of explanations. The research questions are reiterated below:

1. How are multimodal explanations produced by isiZulu, Sesotho, and Tshivenda speakers?
2. Does age affect multimodal explanatory skills in isiZulu, Sesotho, and Tshivenda?

This chapter presents the results from the quantitative analysis of the elicited oral explanation production task of group 1 (5–6 year olds) and group 2 (9–10 year olds) in three languages. The transcribed data on the ELAN software were exported to Excel and SPSS for a quantitative analysis. This analysis commences with the results of speech, and this is subsequently followed the analysis of age.

Research Question 1: How are multimodal explanations produced by isiZulu, Sesotho, and Tshivenda speakers?

To address the first research question, the dependent variables are clauses, pragmatic acts, clauses per explanation type, explanation accuracy, and gesture. These were analysed with respect to their relationship to the independent variable, language.

4.1 Speech Analysis

A non-parametric inferential was used to analyse this. For the analysis of this, a Kruskal-Wallis test was used. In order to investigate the underlying structures of explanations and how events were related in the production of explanations, the explanations were segmented into clauses. The segmentation of the clauses is the first point of analysis to measure the informational quantity of the explanations that were produced.

4.1.1 Clauses

The clause was used as the unit of analysis. A clause is defined as having a verbal and several arguments. To further extrapolate a definition, a clause is a continuation of words including a verb matched by its satellites as subjects and complement(s). Table 5 shows the findings.

Table 5: Mean number of clauses across language groups

		Mean
Languages	IsiZulu	14
	Sesotho	24
	Tshivenda	14

From Table 5, it is clear that the Sesotho group has the highest mean number of clauses compared to the other two language groups. This means that the Sesotho group participants produced more clauses than other participants in the other two language groups. Both isiZulu and Tshivenda groups showed the same lowest mean number of clauses. This means that both the isiZulu and Tshivenda groups' participants produced the same mean number of clauses, and this proved to be lower than the mean number of clauses in the Sesotho group. Participants in these two language groups produced fewer clauses than participants in the Sesotho group. Figure 4 illustrates this observation.

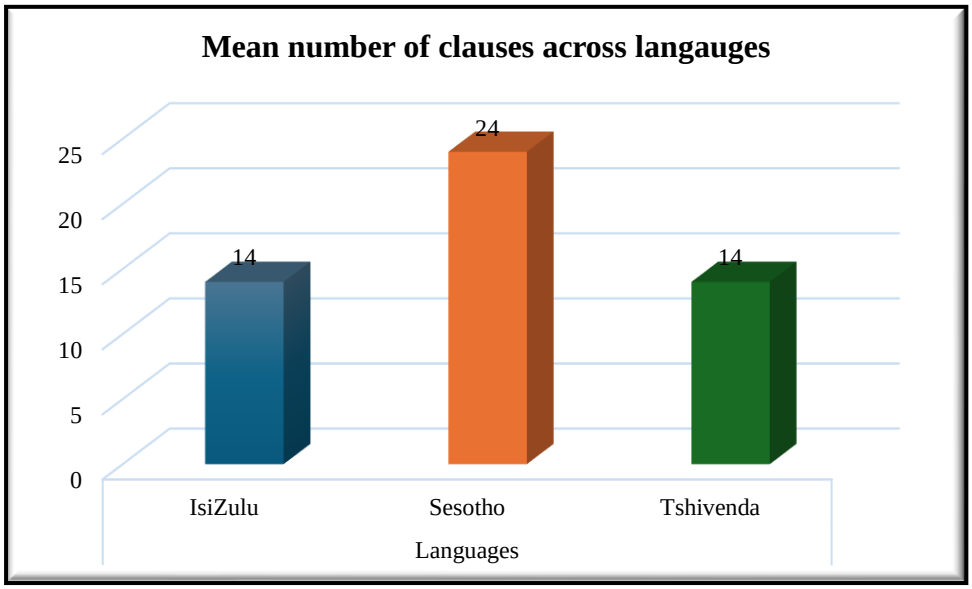


Figure 4: Mean number of clauses across languages

These results are a brief summary, showing that the Sesotho group participants produced their responses in more clauses than other participants in the other two language groups. Figure 4

further shows that both the isiZulu and Tshivenda groups participants were able to produce their responses in fewer clauses than the Sesotho group participants.

Subsequently, we performed a Kruskal-Wallis test, and this indicated that there was a significant difference in the production of clauses across the three languages, p = [.036]. Table 6 provides the statistical results of the clauses produced by all participants in the three languages.

Table 6: Mean number of clauses across the three language groups

		Num. of participants	*Mean Rank*
Languages	IsiZulu	20	28,33
	Sesotho	20	38,40
	Tshivenda	20	24,78

As can be seen in Table 6, there was a statistical difference in the mean number of clauses across the three language groups. The Sesotho group had the highest mean rank number of [38.40] in the production of clauses. The isiZulu group had the second highest mean rank number of [28.33], and lastly, the Tshivenda group had the lowest mean rank number of [24.78] in the production of clauses.

Post-hoc comparisons using the Kruskal-Wallis method with the Bonferroni corrections for multiple tests indicated that there was no significant difference in the production of clauses between the Tshivenda and isiZulu groups, and between the isiZulu and Sesotho groups. There was, however, a significant difference between the Sesotho and Tshivenda groups, p = [.039] in the production of clauses.

4.1.2 Pragmatic Acts

In the analysis of our data of the production of explanations, we measured the pragmatic acts of the clauses. Clauses were categorised in terms of their pragmatic acts. As explained in the methodology chapter, this looks at what each clause expresses in line with the stimuli. The clauses were categorised as acts of narrating, explaining, interpreting, and commenting. Pragmatic acts provide information on the strategy used by the speakers when producing an explanation. Table 7 shows the obtained results.

Table 7: Mean number of pragmatic acts per language group

		Narrative	Explain	Interpret
Languages	IsiZulu	7	4	1
	Sesotho	17	4	3
	Tshivenda	6	6	1
	Total Mean	**30**	**14**	**5**

Table 7 presents the pragmatic act usage in all the language groups, with the narrative act being the most frequent. The explaining pragmatic act is the second most frequent and interpreting is the least frequent.

IsiZulu

In this language group, the most frequent pragmatic act is narrating. This is followed by the explaining pragmatic act, and lastly, by the interpreting pragmatic act. There were no commentary pragmatic acts in the explanations of the isiZulu participants.

Sesotho

In the Sesotho group, table 7 reveals that the participants produced the highest mean number of narrating pragmatic act. The second highest mean number was produced in the explaining pragmatic act. The interpreting pragmatic act in the language had the lowest mean number. Like in the isiZulu group, there are no commentary pragmatic acts in this language group.

Tshivenda

In the Tshivenda group, we note that there was a similar mean number of the narrating and explaining pragmatic acts. Like in the other two languages above, there were few interpreting pragmatic acts in this language group. Lastly, there was no commentary of pragmatic acts in this language group as well.

Overall, the results demonstrate that all the language groups had a narrative focus in this task. Even though the narrative pragmatic act is high in the isiZulu and Tshivenda groups, it was not as high as it was in the Sesotho group. The results further demonstrate that both the isiZulu and Sesotho groups had a similar mean number of explaining clauses. This was, however, lower than the mean number explaining the pragmatic act in the Tshivenda group. This shows that the Tshivenda group participants made more explaining pragmatic acts than participants in both the isiZulu and Sesotho groups. Lastly, the results demonstrate that across the three language groups, the interpreting pragmatic act was infrequently utilised compared to the narrative and explaining pragmatic acts. This suggests that participants in the three language groups were

less inclined to give interpretations. Figure 5 illustrates this, focusing only on the narrative, explaining, and interpreting pragmatic acts.

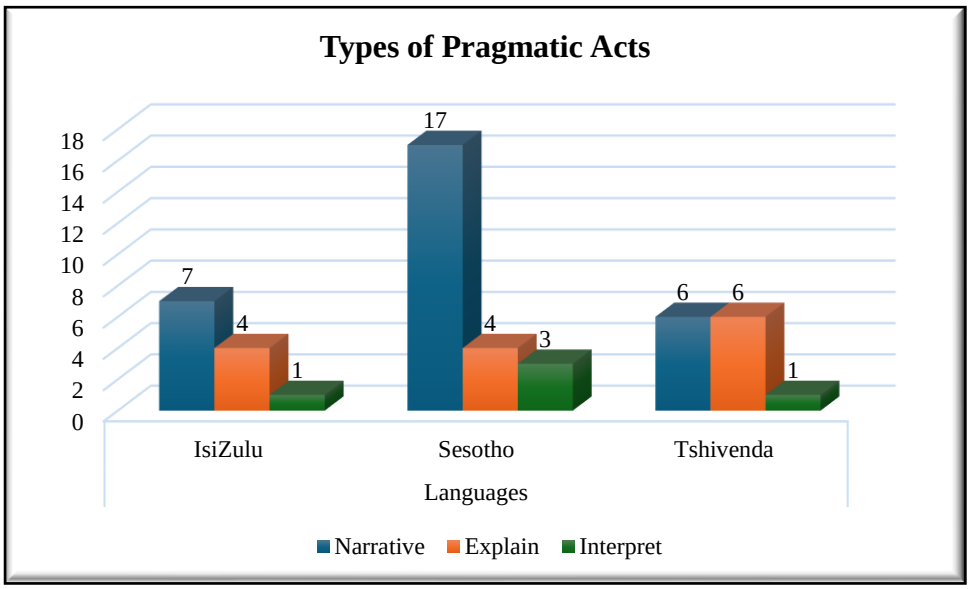


Figure 5: Mean number of narrative, explaining, and interpreting pragmatic acts across the language groups

Figure 5 illustrates that across the three language groups, the Sesotho group had the highest mean number of narrating pragmatic act. The isiZulu group had the second highest mean number of narrating pragmatic acts, and the Tshivenda group had the lowest mean number of narrating pragmatic acts. Furthermore, Figure 5 illustrates that the mean number of explaining pragmatic acts is higher in the Tshivenda group than in the other two language groups. Both isiZulu and Sesotho groups had the same mean number of explaining pragmatic act. In the group representing the interpreting pragmatic act, the Sesotho group had a highest mean number than the other two language groups. Both isiZulu and Tshivenda groups had the same low mean number of this pragmatic act.

Subsequently, we performed a Kruskal-Wallis test, and out of the three pragmatic acts (narrating, explaining, and interpreting), the interpreting pragmatic act was not statistically significant across the three language groups. This means that there was no significant difference in the production of interpreting the pragmatic act across the three language groups. Only the narrating and explaining pragmatic acts were statistically significant across the three language groups. Table 8 demonstrates this.

Table 8: Mean rank number of narrating and explaining pragmatic acts across the three language groups

	Languages	*Num. of participants*	*Mean Rank*
Narrating	IsiZulu	20	29,33
	Sesotho	20	38,18
	Tshivenda	20	24,00
Explaining	IsiZulu	20	27,50
	Sesotho	20	24,75
	Tshivenda	20	39,25

The Kruskal-Wallis test demonstrated that there is a significant difference in the production of the narrating pragmatic act across the three languages, p = [.026]. The Sesotho group had the highest mean rank number of [38.18] in the production of the narrating pragmatic act. The isiZulu group had the second highest mean rank number of [29.33], and lastly, the Tshivenda group had the lowest mean rank number of [24.00] in the production of this pragmatic act.

Post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no statistical significance in the production of the narrating pragmatic act between isiZulu and Tshivenda groups, and between isiZulu and Sesotho groups. A statistical significance was observed between Sesotho and Tshivenda groups, p = [.026]. These results suggest that there is no difference in the production of narrating pragmatic acts between the isiZulu and Tshivenda groups, and between the isiZulu and Sesotho groups. However, there is a difference in the production of narrating pragmatic acts between the Sesotho and Tshivenda groups.

In the explaining pragmatic act, the Kruskal-Wallis test also indicated that there was a significant difference across the three languages, p = [.017]. The Tshivenda group had the highest mean rank number of [39.35] when producing explaining the pragmatic act. The isiZulu group had the second highest mean rank number of [27.50], and lastly, the Sesotho group had the lowest mean rank number of [24.75] when producing the explaining pragmatic act.

Post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference in the production of the explaining pragmatic act between Sesotho and isiZulu, and between isiZulu and Tshivenda. There was,

however, a statistical significance between Sesotho and Tshivenda groups, p = [.022]. This suggests that there is a difference in the number of explaining pragmatic acts between Sesotho and Tshivenda groups.

4.1.3 Clauses per explanation type

The study focused on four types of explanations – Hypothesis Formulation explanation, Procedural explanation, Theory of Mind explanation, and Causal explanation. Here, we looked at how many clauses were generated in each type of explanation. Table 9 shows the findings.

Table 9: Mean number of clauses per explanation type across language groups

		Hypothesis Formulation explanation	**Procedural explanation**	**Theory of Mind explanation**	**Causal explanation**
Languages	IsiZulu	2	8	2	2
	Sesotho	7	9	5	3
	Tshivenda	4	4	3	3
	Total Mean	**13**	**21**	**10**	**8**

Table 9 presents the mean number of clauses per explanation type in all the language groups. As it can be seen in the table, the Procedural explanation type has the highest mean number of clauses. The Hypothesis Formulation explanation type has the second highest mean number of clauses across the language groups. The Theory of Mind explanation type has the third-highest mean number of clauses, and lastly, the Causal explanation type has the lowest mean number of clauses across the language groups.

Hypothesis Formulation Explanation

As Table 9 demonstrates, all the three language groups had varied mean number of clauses in this explanation type. Compared to the other types of explanations, the Hypothesis Formulation explanation type had the second highest mean number of clauses. In this explanation type, the Sesotho group had the highest mean number of clauses when producing Hypothesis Formulation explanations. The Tshivenda group had the second highest mean number of clauses when producing this explanation type, and lastly, the isiZulu group had the lowest mean number of clauses when producing this type of explanation.

Procedural Explanation

As table 9 reveals, compared to the other explanation types, the Procedural explanation type had the highest mean number of clauses. In this explanation type, the Sesotho group had the

highest mean number of clauses when producing Procedural explanations. The isiZulu group had the second highest mean number of clauses when producing this type of explanation, and lastly, the Tshivenda group had the lowest mean number of clauses when producing this type of explanation.

Theory of Mind Explanation

Compared to the other types of explanations, the Theory of Mind explanation type had the third highest mean number of clauses. In this explanation type, the Sesotho group had the highest mean number of clauses when producing Theory of Mind explanation. The Tshivenda group had the second highest mean number of clauses when producing this explanation type, and lastly, the isiZulu group had the lowest mean number of clauses when producing this type of explanation.

Causal Explanation

Finally, as Table 9 highlights, the Causal explanation type had the lowest mean number of clauses compared to the other explanation types. In this type of explanation, both the Sesotho and Tshivenda groups had the same higher mean number of clauses. The isiZulu group had the lower mean number of clauses when producing this type of explanation.

Table 9 further shows more important information about the three language groups. In analysing the isiZulu group, as the table reveals, the language group had the highest mean number of clauses in the Procedural explanation type when compared to the other three explanation types. In contrast, these other three explanation types, (Hypothesis Formulation, Theory of Mind, and Causal), showed little variation in mean number of clauses in this language group.

In analysing the Sesotho group, as the table 9 highlights, this language group had the highest mean number of clauses in the Procedural explanation type. The language group had the second highest mean number of clauses in the Hypothesis Formulation explanation type. The language group had the third highest mean number of clauses in the Theory of Mind explanation type. Lastly, the language group had the lowest mean number of clauses in the Causal explanation.

In analysing the Tshivenda group, we note that the language group had the same highest mean number of clauses in both the Hypothesis Formulation and Procedural explanation types. The language group had the same lowest mean number of clauses in both the Theory of Mind and Causal explanations.

Overall, as seen in table 9, the Procedural explanation type had the highest mean number of clauses in all the language groups (having the same mean number of clauses with Hypothesis Formulation explanation in the Tshivenda group). Other types of explanations were lower in all the language groups. Figure 6 illustrates this.

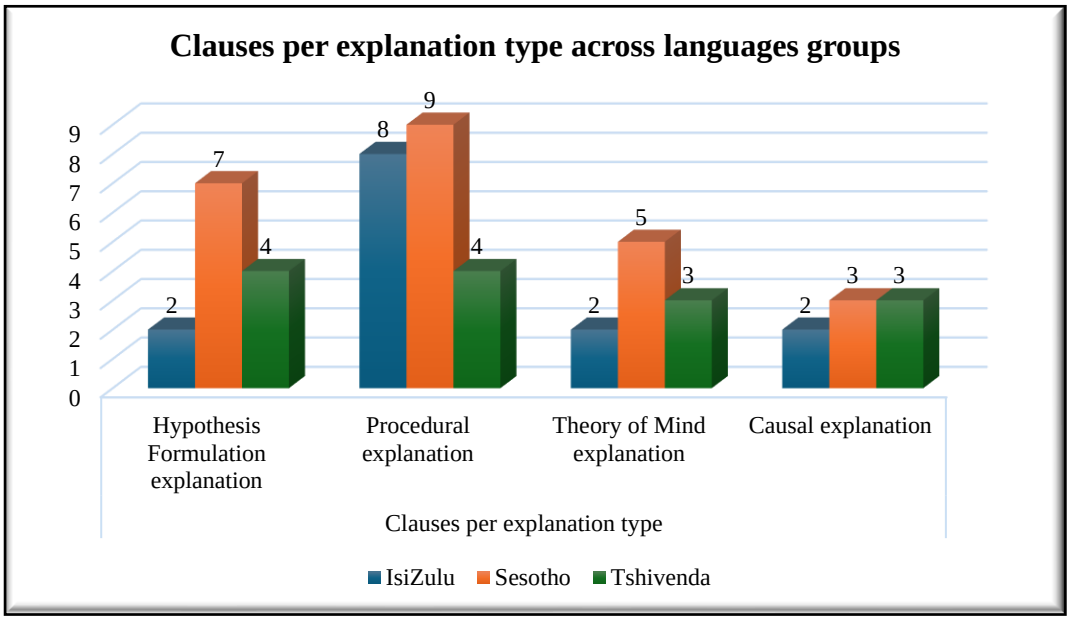


Figure 6: Mean number of clauses per explanation type across the three language groups

Figure 6 illustrates that the three language groups had the highest mean number of clauses in the Procedural explanation type. In the Tshivenda group, however, the mean number of clauses in the Procedural explanation type was similar to the mean number of clauses in Hypothesis Formulation explanation type. Out of the three language groups, the Sesotho group had the highest mean number of clauses in the Procedural explanation type. As the figure demonstrates, the mean number of clauses in the Hypothesis Formulation explanation type in both the Sesotho and isiZulu groups was lower than the mean number of clauses in the Procedural explanation type. Out of the three language groups, the Sesotho group had the highest mean number of clauses in the Hypothesis Formulation explanation type. In analysing the mean number of clauses in the Theory of Mind explanation, figure 6 illustrates that in both the Sesotho and Tshivenda groups, this was lower than both the Hypothesis Formulation and Procedural explanation types. Amongst the three language groups, the Sesotho group had the highest mean number of clauses in the Theory of Mind explanation. Lastly, in the Causal explanation type, Figure 6 shows that this was lower than all the other explanation types in the Sesotho group. However, in the Tshivenda group, we note that the mean number of clauses in the Causal explanation was similar to the mean number of clauses in the Theory of Mind explanation.

When observing the isiZulu group, we note the number of clauses was similar in all the explanation types except in the Procedural explanation. Amongst all the language groups, both the Sesotho and Tshivenda groups had the highest mean number of clauses in this explanation type.

Subsequently, a Kruskal-Wallis test was performed, and out of the four explanations type, the test indicated that there was no significant difference in the production of clauses in both Hypothesis Formulation and Causal explanations across the three language groups. A significant difference was only observed in both the Procedural and Theory of Mind explanation types. Table 10 shows the statistical results.

Table 10: Mean rank number of clauses in Procedural and Theory of Mind explanation types across the language groups

	Languages	*Num. of participants*	*Mean Rank*
Procedural Explanation	IsiZulu	20	34,20
	Sesotho	20	35,28
	Tshivenda	20	20,95
Theory of Mind Explanation	IsiZulu	20	24,18
	Sesotho	20	33,93
	Tshivenda	20	33,40

The test demonstrated that there was a significant difference in the production of clauses in Procedural explanations across the three languages, p = [.008]. The Sesotho group had the highest mean rank number of [35.28] in the production of clauses in the Procedural explanation. The isiZulu group had the second-highest mean rank number of [34.20], and lastly, the Tshivenda group had the lowest mean rank number of [20.95] in the production of clauses in this explanation type.

Post-hoc comparisons were done in order to understand the specific differences. A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference in the production of clauses in Procedural explanation between the Sesotho and isiZulu groups. The test showed that there was a significant difference in the production of clauses in Procedural explanation between the Tshivenda and Sesotho groups, p = [.021], and between the Tshivenda and isiZulu groups, p = [.020].

The test also demonstrated that there was significant difference in the production of clauses in Theory of Mind explanation across the three languages, p = [.022]. The Sesotho group had the highest mean rank number of [33.93] in the production of clauses in the Theory of Mind explanation. The Tshivenda group had the second highest mean rank number of [33.40], and lastly, the isiZulu group had the lowest mean rank number of [24.18] in the production of clauses in this explanation type.

A post-hoc comparison using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference in the production of clauses in Theory of Mind explanation between the Tshivenda and Sesotho groups. It indicated, however, that there was a significant difference between the isiZulu and Sesotho groups, p = [.043], and between Tshivenda and isiZulu, p = [.042].

4.1.4 Response Accuracy

This section analyses the responses that the participants gave. As explained in the method chapter, the interviewer asked each participant four questions that were related to the cartoon. All correct responses were coded as ‘correct’, incorrect responses were coded as 'incorrect’, and partially correct responses were coded as 'partial’. Table 11 shows the obtained results.

Table 11: Total mean number of response accuracy per explanation type across language groups

		Hypothesis Formulation Explanation			**Procedural Explanation**			**Theory of Mind Explanation**			**Causal Explanation**		
		Correct	Partial	Incorrect	Correct	Partial	Incorrect	Correct	Partial	Incorrect	Correct	Partial	Incorrect
Languages	IsiZulu	1	0	19	7	9	4	10	0	10	12	2	6
	Sesotho	4	0	16	8	8	4	7	0	13	10	2	8
	Tshivenda	7	0	13	3	7	10	3	7	10	6	0	14
Total Mean		**4**	**0**	**16**	**6**	**8**	**6**	**7**	**2**	**11**	**9**	**1**	**9**

As Table 11 demonstrates, there is a variation in response accuracy across the explanation type. Participants across the language groups performed better in the Causal explanation and had lower performance results in the Hypothesis Formulation explanation. This shows that participants were able to give more correct responses when responding to the question of causation and causality than when responding to the question of formulating a hypothesis.

Hypothesis Formulation Explanation Response

When looking at the responses given by the participants the Hypothesis Formulation, we note that all three language groups had the highest number of incorrect responses. The number of correct responses was low compared to the incorrect responses. Furthermore, it is noted that participants in all these languages did not have any partially correct responses. For this explanation, the Tshivenda group had the highest number of correct responses. This was followed by the Sesotho and isiZulu groups, respectively. The isiZulu group had the highest number of incorrect responses. This was followed by the Sesotho and Tshivenda groups, respectively. The results indicate that the isiZulu group had lower performance results in terms of number of correct responses when compared to the other two language groups.

Procedural Explanation Response

In analysing the responses given by the participants for the Procedural explanation, there is a balanced distribution of correct and incorrect responses. This means that the total mean number of correct responses is similar to the total mean number of incorrect responses in this explanation type. For this explanation type, the Sesotho group had the highest number of correct responses. This was followed by the isiZulu and Tshivenda groups, respectively. Tshivenda had the highest number of incorrect responses. This was followed by the Sesotho and isiZulu groups with the same number of incorrect responses. The isiZulu group had the highest number of partially correct responses. This was followed by the Sesotho and Tshivenda groups, respectively. As mentioned above, the results of this explanation type demonstrate a balanced distribution of correct and incorrect responses across all the language groups.

Theory of Mind Explanation Responses

In analysing the responses given by the participants in the Theory of Mind explanation, there are more incorrect responses than correct and partially correct responses. For this explanation type, the isiZulu group had the highest number of correct responses. This was followed by the Sesotho and Tshivenda groups, respectively. When looking at the incorrect responses, we note

that the Sesotho group had the highest number. This was followed by both the isiZulu and Tshivenda groups with the same number. The results further demonstrate that the Tshivenda group had lower performance results in terms of number of correct responses when compared to the other two language groups. However, the language group had more partially correct responses than the other two language groups.

Causal Explanation Responses

In analysing the responses given by the participants in the Causal explanation, we note that there is a balanced distribution of correct and incorrect responses. For this type of explanation, the isiZulu group had the highest number of correct responses. This was followed by the Sesotho and Tshivenda groups, respectively. When looking at the incorrect responses, we note that Tshivenda had the highest number. This was followed by the Sesotho and isiZulu groups, respectively. For this type of explanation, only Sesotho and isiZulu had partially correct response and this was the same. The results indicate that the Tshivenda group had lower performance results in terms of number of correct responses when compared to the other two language groups. As mentioned above, the results of this explanation type demonstrate a balanced distribution of correct and incorrect responses across all the language groups.

Overall, the analysis of the response accuracy in all these explanation types across the three language groups demonstrate that the isiZulu group had more correct responses in the Causal explanation and more incorrect responses in the Hypothesis Formulation explanation. The Sesotho group also had more correct responses in the Causal explanation and more incorrect responses in the Hypothesis Formulation explanation. In contrast, the Tshivenda group had more correct responses in the Hypothesis Formulation and more incorrect responses in the Causal explanation. Figure 7 illustrates this analysis.

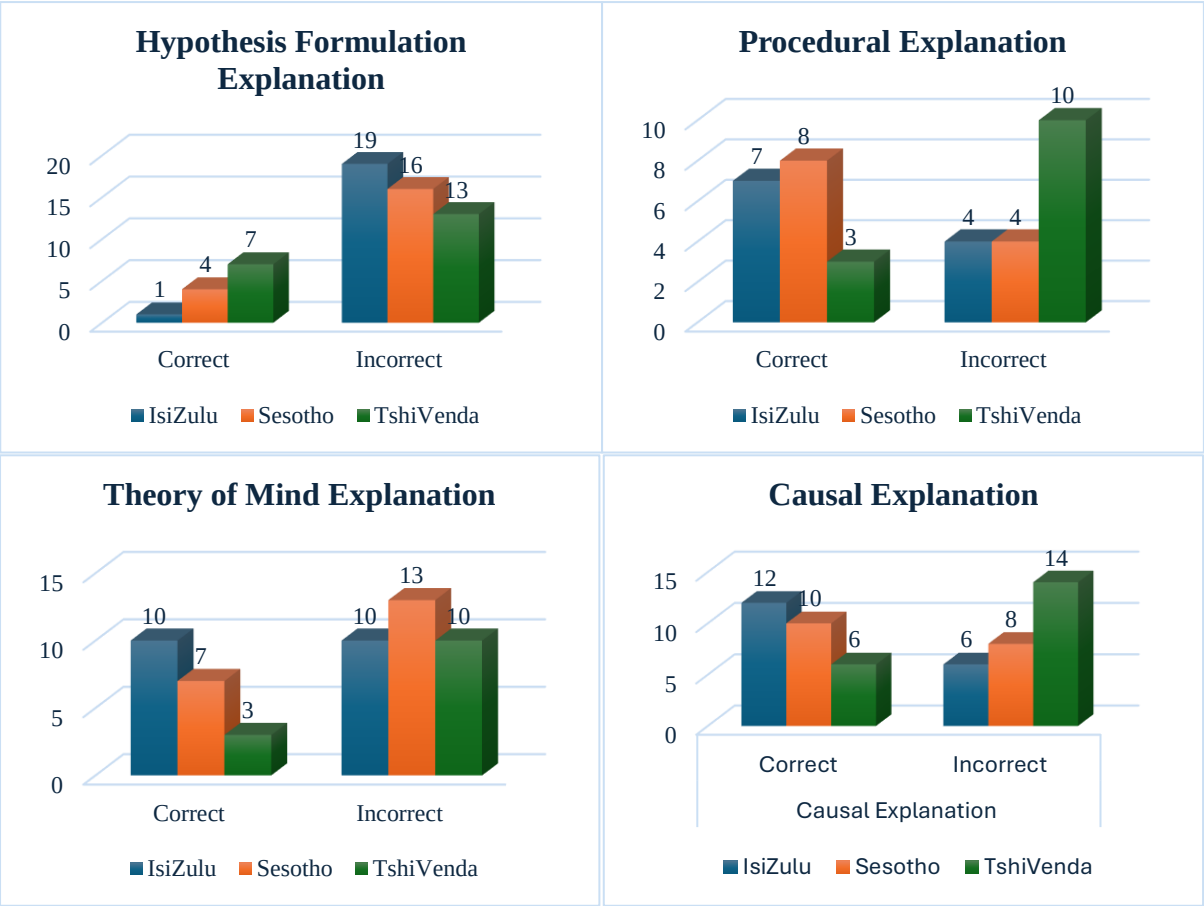


Figure 7: Correct and incorrect responses per explanation type across language groups

Figure 7 illustrates important information regarding the three language groups across the explanation type. As the figure illustrates, the performance of the isiZulu group was not the same in all the explanation types. The language group had more correct responses in the Causal explanation than in any other explanation type. The language group had the second highest number of correct responses in the Theory of Mind explanation. In the Procedural explanation, we note that the language group had the third highest number of correct responses. Lastly, the isiZulu group had the lowest number of correct responses in the Hypothesis Formulation explanation type.

In analysing the Sesotho group, we note that the performance of this language group was not the same in all the explanation types. The language group had the second-highest number of correct responses in the Procedural explanation. This is seen in the fact that the language group had more correct responses in this explanation type than in the other two explanation types. In analysing the Theory of Mind explanation, we note that the language group had the third highest number of correct responses. This is seen in the fact that there are more correct responses in this explanation type than in the Hypothesis Formulation explanation type. Lastly,

the language group had the lowest number of correct responses in the Hypothesis Formulation explanation type.

Finally, in analysing the Tshivenda group, we note that the performance of this language group was not the same in all the explanation types. This language group had more correct responses in the Hypothesis Formulation than in any other explanation types. The language group had the second highest number of correct responses in the Causal explanation. This is seen in the fact that the language group had more correct responses in this explanation type than in the other two explanation types. Lastly, both the Procedural and Theory of Mind explanations had similar number of correct responses. The Tshivenda group had the lowest number of correct responses in both the Procedural and Theory of Mind explanation types.

The language group had the second-highest number of correct responses in the Causal explanation. This is seen in the fact that the language group had more correct responses in this explanation type than in the other two explanation types. Table 12 shows the results.

Table 12: Mean rank number of the response accuracy in the Procedural explanation type across the language groups

	Languages	*Num. of participants*	*Mean Rank*
Procedural Explanation	IsiZulu	20	33,65
	Sesotho	20	34,70
	Tshivenda	20	23,15

Table 12 shows the results of the Kruskal-Wallis test, and this indicate that there was a statistical difference in the response accuracy in the Procedural explanation across the three language groups, p = [.048]. The results show that the Sesotho group had the highest mean rank number of the response accuracy type of [34.70] when producing a Procedural explanation. The isiZulu group had the second-highest mean rank number of the response accuracy of [33.65] when production this explanation type. Lastly, the Tshivenda group had the lowest mean rank number of the response accuracy of [23.15] when producing this type of explanation.

4.1.5 Gesture Analysis

Gesture plays an important role in the development of language. Research has demonstrated that gesture develops in parallel with language. The present study is a multimodal study which encompasses both verbal and co-speech gesture.

Gesture Stroke

Meaningful parts of the gesture i.e. the strokes were analysed. Here, we looked at the production of gesture in each explanation type. Table 13 shows the results that were obtained.

Table 13: Mean number of gesture production in each explanation type across language groups

		Hypothesis Formulation explanation	**Procedural explanation**	**Theory of Mind explanation**	**Causal explanation**
Languages	IsiZulu	0	2	0	0
	Sesotho	3	9	3	1
	Tshivenda	2	0	0	1
Total Mean		5	11	3	2

As it can be seen in table 13 gestures were produced in all explanation types. Across all the explanations type, the table 13 shows that most gestures were produced in the Procedural explanations, and least gestures were produced in the Causal explanations.

Hypothesis Formulation Explanation

As table 13 demonstrates, this explanation type had the second highest mean number of gestures compared to other explanation types. In analysing the gesture production in the Hypothesis Formulation explanation across all the language groups, we note that the Sesotho group produced the highest mean number, and this is lower in the other two language groups. The Tshivenda group produced the second highest mean number of gestures in the Hypothesis Formulation explanation, and the isiZulu group produced the lowest mean number of gestures in this explanation type.

Procedural Explanation

As seen in table 13, Procedural explanation had the highest mean number of gesture production compared to the other explanation types. In analysing the gesture production in this type of explanation across all the three language groups, table 13 shows that the Sesotho group had the highest mean number of gestures. The isiZulu group had the second-highest mean number of gestures in the Procedural explanation, and the Tshivenda group had the lowest mean number of gestures in this explanation type. These results mean that the Sesotho group produced more gestures in this explanation type than the other two language groups.

Theory of Mind Explanation

When examining the Theory of Mind explanation, table 13 reveals that this explanation type has the third-highest mean number of gesture production when compared to other explanation types across the language groups. In this explanation type, we note that the Sesotho group had the highest mean number of gestures, and this is lower in the other two language groups. Both the isiZulu and Tshivenda groups had the same lower number of gesture production in this type of explanation. These results show that the Sesotho group produced more gestures in this type of explanation than the other two language groups.

Causal Explanation

For this type of explanation, table 13 reveals that Causal explanation has the lowest mean number of gesture production compared to the other explanation types across the three language groups. In this type of explanation, we note that both the Sesotho and Tshivenda groups had the same highest mean number. The isiZulu group had the lowest mean number of gestures in this explanation type. These results demonstrate that both the Sesotho and Tshivenda groups produced more gestures in this explanation type than the isiZulu group.

Table 13 further shows important information regarding the three language groups across the explanation types. A further analysis of the table reveals that the isiZulu group produced the highest mean number of gestures in the Procedural explanation. Furthermore, it shows that there are no gestures that were produced in the other explanation types in this language group. These results show that the isiZulu group participants gestured more when producing a Procedural explanation.

In analysing the Sesotho group, table 13 highlights that the language group produced the highest mean number of gestures in the Procedural explanation. Both the Hypothesis Formulation and Theory of Mind explanation types had a similar mean number of gestures in

the language group. Lastly, the language group produced the lowest mean number of gestures in the Causal explanation. These results show that the Sesotho group participants gestured more when producing a Procedural explanation and gestured less when producing a Causal explanation.

Finally, in analysing the Tshivenda group, table 13 reveals that the language group produced the highest mean number of gestures in the Hypothesis Formulation explanation. The language group produced the second-highest mean number of gestures in the Causal explanation. The language group did not produce any gestures when producing both Procedural and Theory of Mind explanation type.

Overall, as table 13 highlights, there were more gestures in the Procedural explanation, and less gestures were produced in the Causal explanation. Furthermore, the Sesotho group produced a higher mean number of gestures in all the explanation types (having the same mean number with the Tshivenda group in the Causal explanation).

Subsequently, we performed a Kruskal-Wallis test, and this indicated that there was a significant difference in gesture production for all the explanation types across the three language groups. Table 14 demonstrates the statistical results of this test.

Table 14: Mean rank number of gesture production per explanation type across language groups

	Languages	*Num. of participants*	*Mean Rank*
Hypothesis Formulation Explanation	IsiZulu	20	21,68
	Sesotho	20	37,28
	Tshivenda	20	32,55
Procedural Explanation	IsiZulu	20	27,53
	Sesotho	20	45,33
	Tshivenda	20	18,65
Theory of Mind Explanation	IsiZulu	20	24,00
	Sesotho	20	39,33
	Tshivenda	20	28,18
Causal Explanation	IsiZulu	20	24,88
	Sesotho	20	35,25
	Tshivenda	20	31,38

Table 14 demonstrates the results of the Kruskal-Wallis test, and this indicates that there was a statistical difference in the production of gesture for all the explanation types in all the three language groups.

Hypothesis Formulation Explanation

As Table 14 indicates, there was a significant difference in the production of gesture in the Hypothesis Formulation explanation across the three languages, p = [.005]. The results show that the Sesotho group had the highest mean rank number of the gesture production [37.28] when giving a Hypothesis Formulation explanation. The Tshivenda group had the second highest mean rank number of the production of gestures [32.55]. Lastly, the isiZulu group had the lowest mean rank number of the production gestures [21.68].

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the isiZulu and Tshivenda groups, and between the Tshivenda and Sesotho groups in the production of gesture in a Hypothesis Formulation explanation. The results, however, indicated that there was a significant difference between the IsiZulu and Sesotho groups, p = [.004].

Procedural Explanation

The Kruskal-Wallis test also demonstrated that there was a significant difference in the production of gesture in the Procedural explanation across the three languages, p = [<.001]. The results further show that the Sesotho group had the highest mean rank number of production of gestures [45.33] when giving a Procedural explanation. The isiZulu group had the second-highest mean rank of the production of gestures [27.53] when producing this explanation type. Lastly, the Tshivenda group had the lowest mean rank number of the production of gestures [18.65] when producing this explanation type.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the isiZulu and Tshivenda groups in the production of gestures in the Procedural explanation. There was, however, a significant difference between Sesotho and Tshivenda groups, p = [<.001], and between the isiZulu and Sesotho groups, p = [.002].

Theory of Mind Explanation

The Kruskal-Wallis test also demonstrated that there was a significant difference in the production of gesture in the Theory of Mind explanation across the three languages, p = [<.001]. The results show that the Sesotho group had the highest mean rank number of the production of gestures [39.33] when producing a Theory of Mind explanation. The Tshivenda group had the second-highest mean rank number of the production of gestures [28.18] when producing this type of explanation. Lastly, the isiZulu group had the lowest mean rank number of the production of gesture [24.00] when producing this explanation type.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the isiZulu and Tshivenda groups in the production of gestures in the Theory of Mind explanation. There was, however, a significant difference between the IsiZulu and Sesotho groups, p = [<.001], and between the Tshivenda and Sesotho groups, p = [.015].

Causal Explanation

Lastly, the Kruskal-Wallis test also demonstrated that there was a significant difference in the production of gesture in the Causal explanation across the three languages, p = [.037]. The Sesotho group had the highest mean rank number of the production of gestures [35.25] when producing a Causal explanation. The Tshivenda group had the second-highest mean rank number of the production of gestures [31.38] when producing this explanation type. Lastly, the isiZulu group had the lowest mean rank number of the production of gestures [24.88] when producing this type of explanation.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the isiZulu and Tshivenda groups, and between the Sesotho and Tshivenda groups in the production of gestures in the Causal explanation. A significant difference is noted between the isiZulu and Sesotho groups, p = [.033].

Gesture Function

The study now aims to look at the functions of the gesture that has been explored above. This means that the co-speech body movements that were identified as gestures were described and classified according to their functions. There were only a few of gestures and mostly were representational, performative and discursive gestures. Table 15 shows the results that were obtained.

Table 15: Mean number of gesture functions across the language groups

		Representational	Performative	Discursive
Languages	IsiZulu	2	1	0
	Sesotho	9	4	3
	Tshivenda	0	2	1
Total Mean		11	7	4

As Table 15 demonstrates, out of all the gesture functions, only three were produced across the three language groups – representational, performative, and discursive. Out of all the gesture functions produced, the highest occurring gesture function was the representational gesture function. This was followed by performative gesture function. The performative gesture function coming second is normal owing to the nature of the task of explaining which is mostly dialogic. Discursive gestures were produced to a lesser extent across the language groups.

Representational

As table 15 shows, the Sesotho group had the highest mean number of representational gesture functions, and this is lower in the other two language groups. The isiZulu group had the second highest mean number of representational gesture functions. Lastly, the Tshivenda group had the lowest mean number of representational gesture functions. These results mean that the Sesotho group produced more gestures that were representational than in their explanations compared to the other two language groups.

Performative

An analysis of this gesture function in table 15 shows that the Sesotho group had the highest mean number of performative gesture functions, and this is lower in the other two language groups. The Tshivenda group had the second highest mean number of performative gesture functions, and, lastly, the isiZulu group had the lowest mean number of this gesture function. These results show that the Sesotho group produced more gestures that were performative gestures such as nodding or shaking of the head in their explanations compared to the other two language groups.

Discursive

An analysis of this gesture function in the table 15 shows that the Sesotho group had the highest mean number of discursive gesture functions. The Tshivenda group had the second highest

mean number of discursive gesture functions, and the isiZulu group had the lowest mean number of this gesture function. These results show that the Sesotho group produced more gestures that clarified or emphasised their verbal information in their explanations compared to the other two language groups.

A further analysis of table 15 provides important information regarding the three language groups across these three gesture functions. An analysis of table 15 further demonstrates that the isiZulu group had the highest mean number of representational gesture functions. Performative gesture functions had the second highest mean number in the language group. There are no discursive gestures in this language group. These results show that the isiZulu group participants produced more representational gestures than other gesture functions when producing their explanations.

In analysing the gesture function usage in the Sesotho group, the table reveals that the majority of the gestures produced were representational, primarily depicting objects or properties of those objects. Performative gestures, which often involve head movements to indicate agreement or disagreement, were the second highest-produced gesture function. Discursive gestures were present in the language. These were the least produced gesture functions. These results show that the Sesotho group participants produced more representational gestures than other gesture functions when producing their explanations.

When examining the gesture usage in the Tshivenda group, table 15 demonstrates that this language group had the highest mean number of performative gesture functions. Discursive gesture functions had the second-highest mean number in the language group. Unlike the two other language groups, there are no representational gestures in this language group. These results show that the Tshivenda group participants produced more performative gestures than other gesture functions when producing their explanations.

Overall, table 15 highlights that there are more representational gesture functions. This means that, across the language groups, explanations were accompanied by more representational gestures. Furthermore, it shows that the Sesotho group produced more representational gestures compared to the other language groups. This means that the language group used more representational gestures in their explanations than other gesture functions.

Subsequently, we performed a Kruskal-Wallis test, and this indicated that there was a significant difference in all the three gesture functions across the language groups. Table 16 demonstrates the statistical results of this test.

Table 16: Mean rank number of gesture functions across the language groups

	Languages	*Num. of participants*	*Mean Rank*
Representational	IsiZulu	20	28,95
	Sesotho	20	43,43
	Tshivenda	20	19,13
Performative	IsiZulu	20	22,30
	Sesotho	20	36,65
	Tshivenda	20	32,55
Discursive	IsiZulu	20	23,50
	Sesotho	20	40,20
	Tshivenda	20	27,80

Table 16 demonstrates the results of the Kruskal-Wallis test which indicate that there was a statistical difference in all the three gesture functions across the three language groups.

Representational

The Kruskal-Wallis test showed that there was a significant difference in the production of representational gesture function across the three languages, p = [<.001]. The Sesotho group had the highest mean rank number of representational gesture function [43.43]. This was followed by the isiZulu group with the mean rank number of [28.95], and the Tshivenda group with the mean rank number of [19.13]. This shows that the Sesotho participants represented more of their gestures than the other two languages.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the Tshivenda and isiZulu groups in the production of representational gesture functions. There was, however, a significant difference between the Tshivenda and Sesotho groups, p = [<.001], and between the isiZulu and Sesotho groups, p = [.010] in the production of this type of gesture function.

Performative

The Kruskal-Wallis test revealed that there was a significant difference in the production of performative gesture functions across the three languages, p = [.012]. The Sesotho group had the highest mean rank number of performative gesture function [36.65]. This was followed by the Tshivenda group with the second-highest mean rank number of [32.55], and the isiZulu group with the lowest mean rank number of [22.30]. These results suggest that Sesotho participants mostly used gestures such as nodding of the head, shaking of the head more than the other two languages.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the Tshivenda and isiZulu groups, and between Tshivenda and Sesotho groups in the production of performative gesture functions. A significant difference is only observed between the isiZulu and Sesotho groups, p = [.012] in the production of this type of gesture function.

Discursive

The Kruskal-Wallis test also revealed that there was a significant difference in the production of discursive gesture function across the three languages, p = [<.001]. The Sesotho group had the highest mean rank number of discursive gesture function [40.20]. This was followed by the Tshivenda group with the second-highest mean rank number of [27.80], and the isiZulu group with the lowest mean rank number of [23.50]. These results suggest that the Sesotho participants used generally brief gestures that aided in structuring speech and discourse than the other two languages.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the Tshivenda and isiZulu language groups in the production of discursive gesture functions. A significant difference is observed between the isiZulu and Sesotho groups, p = [<.001], and between the Tshivenda and Sesotho groups, p = [.007].

Semantic Relations

We subsequently looked at the relationship that gestures have to verbal content. This means that we looked at the relationship that gestures have to the produced explanations. These gestures were coded as reinforcing, supplementing, complementing, integrating, substituting, or contradictory. In our data, there were no semantic relations that were complementary,

contradictory, and substituted to speech. This study, therefore, only analysed gestures that reinforced, integrated, and supplemented the verbal content.

In our analysis, there more gestures that integrated and supplemented verbal content. There were less gestures that reinforced speech. Table 17 shows these results.

Table 17: Mean number of semantic relations across language groups

		Supplements	**Integrates**	**Reinforces**
Languages	IsiZulu	1	2	0
	Sesotho	6	7	4
	Tshivenda	2	0	1
Total Mean		**9**	**9**	**5**

As table 17 demonstrates, out of all the semantic relations, only three were produced across the language groups: supplements, integrates, and reinforces. Out of all the semantic relations produced, the highest occurring semantic relations were both supplementary and integration. Reinforcing gestures were produced to a lesser extent across the language groups. These results mean that explanations that were produced were accompanied by more of gestures that supplemented and integrated meaning.

Supplements

As it can be seen in the table 17, there is a variation in the use of supplementary gestures across the three language groups. The Sesotho group had the highest mean number of gestures that supplemented meaning, and these are lower in the other two language groups. The Tshivenda group had the second highest mean number of supplementary gestures, and the isiZulu group had the lowest mean number of this gesture type. These results show that the Sesotho group used more supplementary gestures in their explanations compared to the other language groups.

Integrating

Table 17 shows that the Sesotho group had the highest mean number of gestures that integrated meaning, and these were lower in the other two language groups. The isiZulu group had the second highest mean number of integrating gestures, and the Tshivenda group had the lowest mean number of this gesture type. These results show that the Sesotho group used more integrating gestures in their explanations compared to the other language groups.

Reinforcing

Lastly, table 17 shows that the Sesotho group had the highest mean number of gestures that reinforced meaning and these are lower in the other two language groups. The Tshivenda group had the second-highest mean number of reinforcing gestures, and the isiZulu group had the lowest mean number of this gesture type. These results show that the Sesotho used more reinforcing gestures in their explanations compared to the other language groups.

A further analysis of the table 17 provides important information regarding the three language groups across these three semantic relations. In analysing table 17, we note that the isiZulu group had more of gestures that integrated meaning. Table 17 further shows that supplementary gestures had the second highest mean number in the language group. This shows that this language group used gestures that added new information that was not coded in the linguistic content. The language group did not use any gestures that reinforced meaning. These results demonstrate that the isiZulu group participants used more gestures that integrated their explanations compared to the semantic relations.

An analysis of table 17 reveals that the Sesotho group had more gestures that integrated meaning. The table further shows that supplementary gestures, which add new information that was not coded in the produced explanations, had the second highest mean number in the language group. Reinforcing gestures had the lowest mean number in the language group. This shows that the language group used gestures that were identical to the linguistic information it was in relation with. This means that the Sesotho group participants used gestures that were identical to their explanations, meaning that these participants in this language group integrated their explanations with gestures

Finally, table 17 indicates that the Tshivenda group had more gestures that supplemented meaning. This shows that the language group used gestures that added new information that was not encoded in the produced explanations. The table further shows that reinforcing gestures, which emphasise or reiterate the linguistic information, had the second highest mean number in the language group. There are no gestures that integrate meaning in this language group. This suggests that there were no gestures that redefined or clarified the produced explanations. These results show that the Tshivenda group participants used more gestures that supplemented their explanations, meaning that their gestures added new information that was not encoded in their explanations.

Overall, table 17 highlights that there are more supplementary and integrating gestures. This means that, across the language groups, explanations were accompanied by more supplementary and integrating gestures. Furthermore, it shows that the Sesotho group produced more of all these semantic relations compared to the other language groups. This means that this language group used more of these semantic relations in their explanations than the other two language groups.

Subsequently, we performed a Kruskal-Wallis test, and this indicated that there was a significant difference in all the three sematic relations across the language groups. Table 18 demonstrates the statistical results of this test.

Table 18: Mean rank number of semantic relations across the language groups

	Languages	*Num. of participants*	*Mean Rank*
Supplements	IsiZulu	20	20,88
	Sesotho	20	39,68
	Tshivenda	20	30,95
Integrates	IsiZulu	20	29,55
	Sesotho	20	42,30
	Tshivenda	20	19,65
Reinforces	IsiZulu	20	24,75
	Sesotho	20	38,60
	Tshivenda	20	28,15

Table 18 demonstrates the results of the Kruskal-Wallis test which indicate that there was a statistical difference in all the three sematic relations across the three language groups.

Supplements

The Kruskal-Wallis test revealed that there was a significant difference in the production of gestures that supplemented meaning across the language groups, p = [<.001]. The Sesotho group had the highest mean rank number of [39.68] when producing supplementary gestures. The Tshivenda group had the second highest mean rank number of [30.95] when producing this gesture type, and the isiZulu group had the lowest mean rank number of [20.88]. These results suggest that the Sesotho participants supplemented their explanations than the participants in the other two languages.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the Tshivenda and isiZulu, and between the Tshivenda and Sesotho groups when producing gestures that supplemented meaning. A significant difference was observed between the isiZulu and Sesotho groups, p = [<.001].

Integrates

The Kruskal-Wallis test revealed that there was a significant difference in the production of gestures that integrated meaning across the language groups, p = [<.001]. The Sesotho group had the highest mean rank number of [42.30] when producing integrating gestures. The isiZulu group had the second highest mean rank number of [29.55] when producing this gesture type, and the Tshivenda group had the lowest mean rank number of [19.65]. These results suggest that the Sesotho participants integrated their explanations than participants in the other two languages. This means that the information that was brought by the gesture added precision to the encoded linguistic information, their explanations.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the Tshivenda and isiZulu groups when producing integrating gestures. A significant difference was observed between the Tshivenda and Sesotho groups, p = [<.001], and between the isiZulu and Sesotho groups, p = [.027].

Reinforces

Lastly, the Kruskal-Wallis test revealed that there was a significant difference in the production of gestures that reinforces meaning across the language groups, p = [.006]. The Sesotho group had the highest mean rank of [38.60] when producing reinforcing gestures. The Tshivenda group had the second-highest mean rank number of [28.15] when producing this gesture type, and the isiZulu group had the lowest mean rank number of [24.75]. These results demonstrate that the Sesotho participants reinforced their explanations with gesture than participants in the other two languages. This means that the information that was brought by the gesture was identical to the linguistic information it was in relation with which was their explanations.

A post-hoc comparisons using Kruskal-Wallis method with a Bonferroni correction for multiple tests indicated that there was no significant difference between the Tshivenda and isiZulu, and between the Tshivenda and Sesotho groups in the production of gestures that reinforce the

linguistic content. There was, however, a significant difference between the isiZulu and Sesotho groups, p = [.007].

4.1.6 Research Question 1 Summary

This section explored the development of explanatory abilities in the three South African Bantu languages – isiZulu, Sesotho, and Tshivenda. The study focused on the speech analysing. The analysis above showed that there is a variation in the performance of explanations across the investigated language groups. The Sesotho group had more clauses than the other two language groups. The analysis further showed that, even though this is an explanatory study, there are more narrative pragmatic acts than the explaining pragmatic acts, indicating that there was a narrative focus.

More clauses were specifically produced in the Procedural explanation type. This clause count is lower in the other three explanation types. The statistical test showed that there was a significant difference in the production of clauses in both the Procedural and Theory of Mind explanations across the language groups, with the Sesotho group producing the highest mean rank number in both explanation types than the other two language group.

The results of the response accuracy showed that there are more incorrect responses in both the Hypothesis Formulation and Theory of Mind explanation types across all the language groups. There is an equal distribution of correct and incorrect response in both the Procedural and Causal explanation types.

When observing the gesture results across all the language groups, we note that the Sesotho group produced more gestures than the other two language groups. The main finding in this analysis is that gesture develops in parallel with speech. Majority of the produced gestures served to add more information to the provided oral explanations through representation.

Research Question 2: Does age affect multimodal explanatory skills in isiZulu, Sesotho, and Tshivenda?

To address the second research question, the dependent variables are clauses, pragmatic acts, clauses per explanation type, explanation accuracy, and gesture. These were analysed with respect to their relationship to the independent variable, age.

4.2 Age Group Analysis

The segmentation of the clauses is the first point of analysis to measure the informational quality of the explanations that were produced. For the analysis of this section, a Mann-Whitney test was used in all variables.

4.2.1 Clauses

As stated above, the clause was used as the unit of analysis. We observed that group 1 (5–6 years age group) had the highest mean number of clauses, and group 2 (9–10 years age group) had the lowest mean number of clauses. Table 19 shows these results.

Table 19: Mean number of clauses in languages across age

		Languages			***Total Mean***
		IsiZulu	Sesotho	Tshivenda	
Age Groups	Group 1	8	16	8	32
	Group 2	6	8	6	20

As it can be seen in table 19, group 1 participants produced more clauses than group 2 participants. Additionally, group 1 participants produced the highest mean number of clauses in all the three language groups than group 2 participants. These results show that the mean number of clauses produced by participants in all these language groups level off with age. This means that as participants increased with age in all these language groups, mean number of clauses decreased in their explanations.

In the Sesotho group, group 1 participants had a high mean number of clauses in their explanations. This mean number of clauses was lower in both the isiZulu and Tshivenda groups in this age group. Table 19 shows that there is a decrease in the mean number of clauses produced by the Sesotho group participants upon reaching 9-10 years old (group 2). This

decrease is also evident in the other two language groups. This shows that there are much fewer clauses in group 2 participants compared to group 1 participants in all the three language groups.

To further understand the explanatory skills of children in each language group, the study examined the developmental trends using mean number of clauses across age groups. Across the three language groups, group 1 participants in the Sesotho group produced the highest mean number of clauses, indicating that their explanations were lengthy. Group 1 participants in both the isiZulu and Tshivenda groups had the same lower mean number of clauses, indicating that their explanations were shorter. In group 2, the Sesotho group participants produced a higher mean number of clauses compared to the other group 2 participants in the other two language groups. Both the isiZulu and Tshivenda group 2 participants produced lower mean number of clauses, indicating that their explanations were shorter than group 2 participants in the Sesotho group.

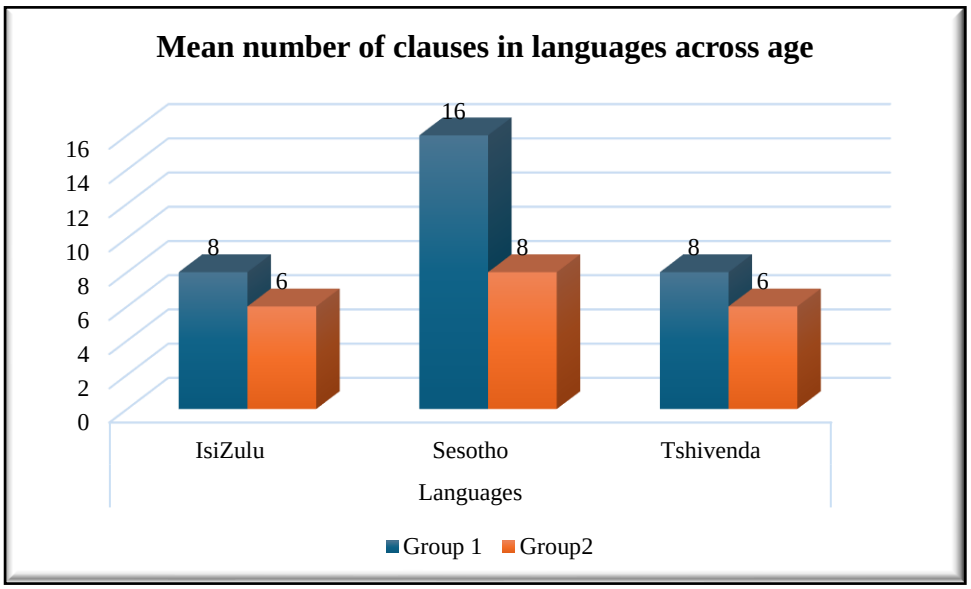


Figure 8: Mean number of clauses in languages across age

From figure 8, we note that there is a trend in the production of clauses across age. The older children produced explanations with fewer clauses than the younger children in all these three language groups. Even though both age groups in the Sesotho group are higher compared to the other two groups in the two languages groups, the trend is the same in that group 1 participants produced more clauses than group 2 participants in all the languages.

Subsequently, we performed a Mann-Whitney test, and this indicated that there was no significant difference in the production of clauses across age. Table 20 shows the statistical results.

Table 20: Mean rank number of the production of clauses across age groups

		Num. of participants	*Mean Rank*
Age Groups	Group 1	30	34,25
	Group 2	30	26,75

4.2.2 Pragmatic Acts

The clauses were categorised in terms of their pragmatic acts. These clauses were segmented as acts of narrating, explaining, interpreting, and commenting. Out of these four pragmatic acts, only three – narrating, explaining, and interpreting were produced. Table 21 shows the results.

Table 21: Mean number of narrating, explaining, and interpreting pragmatic acts in languages across age

Languages	**Age Groups**	**Pragmatic Acts**		
		Narrating	Explaining	Interpreting
IsiZulu	Group 1	4	1	1
Sesotho		12	1	2
Tshivenda		3	2	1
Total Mean Group 1		**19**	**4**	**4**
IsiZulu	Group 2	3	3	0
Sesotho		5	3	1
Tshivenda		3	4	0
Total Mean Group 2		**11**	**10**	**1**

As can be seen in Table 21, participants only produced the narrating, explaining, and interpreting pragmatic acts. There was no commenting pragmatic act. The table shows that in both age groups, the narrating pragmatic act had the highest mean number. The explaining pragmatic act had the second-highest mean number, and lastly, the interpreting pragmatic act had the lowest mean number.

Narrating Pragmatic Act

As table 21 above demonstrates, group 1 participants produced the highest mean number of narrating pragmatic act compared to the group 2 participants, who had fewer narrating pragmatic act. The table shows that in the isiZulu group, the mean number of narrative pragmatic act lowers. Group 1 participants in this language group had a higher mean number

of narrative pragmatic act, and group 2 participants had a fewer mean number of narrative pragmatic act. The same trend is evident in the Sesotho group. In analysis the Tshivenda group, we note that both age groups had similar mean number of narrative pragmatic act.

Explaining Pragmatic Act

In this pragmatic act, table 21 shows that group 2 participants produced the highest mean number of explaining pragmatic act compared to the group 1 participants, who produced fewer explaining pragmatic act. The table further shows that in the isiZulu group, the mean number of explaining pragmatic act increases. Group 2 participants in this language group had higher mean number of explaining pragmatic act, and group 1 participants, in contrast, had fewer mean number of explaining pragmatic act. The same trend is also evident in the Sesotho group. Group 2 participants had more explaining pragmatic act than group 1 participants in this language group. The Tshivenda group also shows a similar trend. The mean number of explaining pragmatic act increases in group 2 participants.

Interpreting Pragmatic Act

In this pragmatic act, table 21 above demonstrates that group 1 participants produced the highest mean number of interpreting pragmatic act compared to group 2 participants, who produced fewer interpreting pragmatic act. The table further shows that in the isiZulu group, the mean number of interpreting pragmatic act decreases. Group 1 participants in this language group had higher mean number of interpreting pragmatic act, and group 1 participants, in contrast, had fewer mean number of interpreting pragmatic act. The same trend is also evident in the Sesotho group. Group 1 participants had more interpreting pragmatic act than group 2 participants in this language group. The Tshivenda group also shows a similar trend. The mean number of interpreting pragmatic act decreases in group 2 participants.

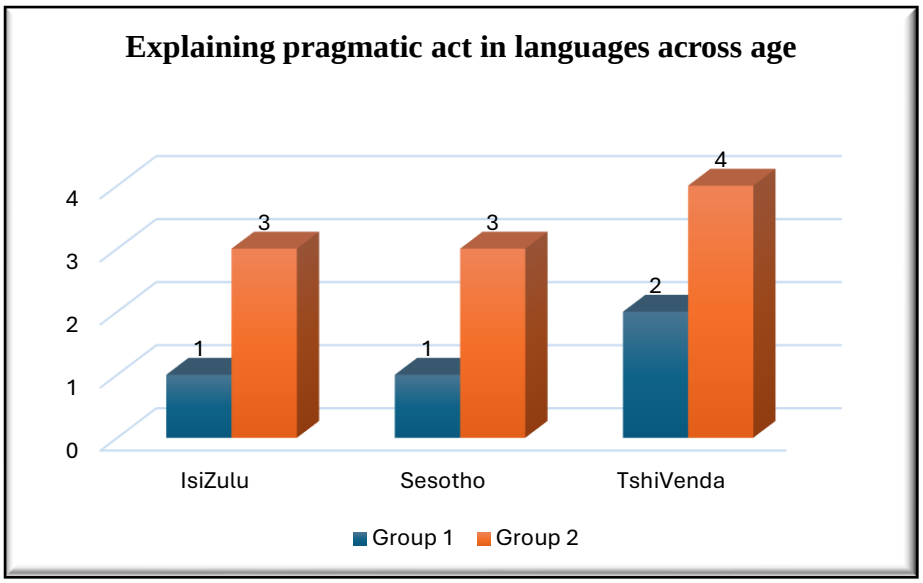


Figure 9: Mean number of explaining pragmatic act in languages across age

As figure 9 illustrates, there is a trend between the age group across the three languages in the ability to produce explaining pragmatic act. In all the three language groups, the figure depicts an increase in the production of the pragmatic act related to explaining. Group 2 participants produced more explaining pragmatic acts than group 1 participants.

Subsequently, we performed a Mann-Whitney test, and this indicated that there was no significant difference in the production of narrating and interpreting pragmatic acts across the age groups. A significant difference was only observed in the explaining pragmatic act. Table 22 shows the statistical results.

Table 22: Mean rank number of explaining pragmatic act across the age groups

	Age Groups	*Num. of participants*	*Mean Rank*
Explains	Group 1	30	26,10
	Group 2	30	34,90

The Mann-Whitney test indicated that there was a significant difference in the production of explaining pragmatic act across the two age groups, p = [.046]. Group 2 participants had the highest mean rank number of [34.90] when producing explaining pragmatic acts, and group 1 participants had the lowest mean rank number of [26.10] when producing this pragmatic act. These results suggest that there is likely a difference in the production of explaining pragmatic acts between the two age groups.

4.2.3 Clause per explanation type

As stated above, the study focused on four types of explanations – Hypothesis Formulation explanation, Procedural explanation, Theory of Mind explanation, and Causal explanation. Here we looked at how many clauses were generated in each type of explanation, focusing on the two age groups. Table 23 shows the obtained results.

Table 23: Mean number of clauses per explanation type in language across age

Languages	Age groups	Explanation types			
		Hypothesis Formulation Explanation	**Procedural Explanation**	**Theory of Mind Explanation**	**Causal Explanation**
IsiZulu	Group 1	1	4	1	1
Sesotho		6	5	4	1
Tshivenda		2	2	2	1
Total Mean		**9**	**11**	**7**	**3**
IsiZulu	Group 2	1	4	1	1
Sesotho		1	4	1	2
Tshivenda		2	2	1	2
Total Mean		**4**	**10**	**3**	**5**

Table 23 shows a comparison of the mean number of clauses per explanation type in the age groups. We note a downward trend, indicating that group 2 participants produced fewer clauses in all types of explanations (except in the Causal explanation type) compared to the group 1 participants.

Hypothesis Formulation Explanation

In the Hypothesis Formulation explanation type, as table 23 demonstrates, group 1 participants had a higher mean number of clauses than group 2 participants. As seen in the table, the mean number of clauses in the Hypothesis Formulation explanation type in the isiZulu group is the same in both age groups. This means that both group 1 and group 2 participants in this language group produced the same mean number of clauses in this explanation type. In contrast, this is not the case in the Sesotho group. In this language group, group 1 participants produced more clauses in the Hypothesis Formulation explanation type than group 2. This is also evident in the Tshivenda group. The mean number of clauses in this explanation type decreases with age, meaning that group 2 participants produced fewer clauses in the Hypothesis Formulation explanation type than group 1 participants.

Procedural Explanation

In the Procedural explanation, table 23 reveals that group 1 participants produced more clauses than group 2 participants, who produced fewer clauses in this explanation type. The table further reveals that in the isiZulu group, the mean number of clauses in the Procedural explanation is the same in both age groups. This means that both group 1 and group 2 participants in this language group produced the same mean number of clauses in this explanation type. In contrast, this is not the case in the Sesotho group. In this language group, group 1 participants produced more clauses in the Procedural explanation type than group 2 participants. In the case of the Tshivenda group, this is the same as the case of isiZulu group. The mean number of clauses in the Procedural explanation is the same in both age groups. This means that both group 1 and group 2 participants in this language group produced the same mean number of clauses in this explanation type.

Theory of Mind Explanation

In the Theory of Mind explanation, the table demonstrates that group 1 participants produced more clauses than group 2 participants, who produced fewer clauses in this explanation type. Table 23 further demonstrates that in the isiZulu group, the mean number of clauses in the Theory of Mind explanation is the same in both age groups. This means that both group 1 and group 2 participants in this language group produced the same mean number of clauses in this explanation type. In contrast, this is not the case in the Sesotho group. In this language group, group 1 participants produced more clauses in the Theory of Mind explanation type than group 2 participants. This is also evident in the Tshivenda group. The mean number of clauses in this explanation type decreases with age, meaning that group 2 participants produced fewer clauses in the Theory of Mind explanation type than group 1 participants.

Causal Explanation

In the Causal explanation, table 23 reveals that group 2 participants produced more clauses than group 1 participants, who produced fewer clauses in this explanation type. This is different from the trend that is observed in the other three explanation types where group 1 participants produced more clauses in each explanation type than group 2 participants. Table 23 further reveals that in the isiZulu group, the mean number of clauses in the Causal explanation is the same in both age groups. This means that both group 1 and group 2 participants in this language group produced the same mean number of clauses in this explanation type. In contrast, this is not the case in the Sesotho group. In this language group, group 2 participants produced more clauses in the Causal explanation than group 1 participants. This is also evident in the

Tshivenda group. In this language group, the mean number of clauses in this explanation type increases with age, meaning that group 1 participants produced fewer clauses in the Causal explanation type than group 2 participants.

Overall, as table 23 reveals, the production of clauses per explanation type decreases with age. However, this is only evident in three explanation types – Hypothesis Formulation explanation, Procedural explanation, and Theory of Mind explanation. In contrast, the number of clauses in Causal explanation increases with age. In all the explanation types, both age groups in the isiZulu group had similar number of clauses. However, in both the Sesotho and Tshivenda groups, both group 1 and group 2 participants showed a downward trend in the three explanation types (except in both the Hypothesis Formulation and Procedural explanation types where both age groups had a similar mean number of clauses in the Tshivenda group). In the Causal explanation, in contrast, there was an upward trend where the mean number of clauses increased with age in both the Sesotho and Tshivenda groups.

Subsequently, we performed a Mann-Whitney test, and out of the four explanation types, the test indicated that there was no significant difference in the production of clauses in both Procedural explanation and Causal explanation across the two age groups. The test indicated that there was a significant difference in the Hypothesis Formulation and Theory of Mind explanation types. Table 24 demonstrates the results.

Table 24: Mean rank number of production of clauses in the Hypothesis Formulation and Theory of Mind explanation types across age groups

	Age Groups	*Num. of participants*	*Mean Rank*
Hypothesis Formulation Explanation	Group 1	30	36,08
	Group 2	30	24,92
Theory of Mind Explanation	Group 1	30	34,70
	Group 2	30	26,30

The Mann-Whitney test indicated that there was a significant difference in the production of clauses in Hypothesis Formulation explanation across the two age groups, p = [.003]. Group 1 participants had the highest mean rank number of [36.08] when producing clauses in the

Hypothesis Formulation explanation. Group 2 participants had the lowest mean rank number of [24.92] when producing clauses in this explanation type.

The Mann-Whitney test also demonstrated that there was a significant difference in the production of clauses in the Theory of Mind explanation across the two age groups, p = [.010]. Group 1 participants had the highest mean rank number of [34.70] when producing clauses in the Theory of Mind explanation. Group 2 participants had the lowest mean rank number of [26.30] when producing clauses in this explanation type. These statistical results indicate that group 1 participants produced longer clauses in these two types of explanations than group 2 participants. Furthermore, these results are consistent with the clauses results above which demonstrate that older children produced fewer clauses than younger children.

4.2.4 Response Accuracy

The analysis of the response across age was also performed. As stated above, this allowed us to determine the type of responses the participants gave in response to the question. All correct responses were coded as ‘correct’, incorrect responses were coded as 'incorrect’, and partially correct responses were coded as 'partial’. The results are shown in Table 25.

Table 25: Total mean number of response accuracy in the explanation type in all language groups across age

Languages	**Age groups**	**Explanation types**											
		Hypothesis Formulation Explanation			**Procedural Explanation**			**Theory of Mind Explanation**			**Causal Explanation**		
		Correct	Partial	Incorrect	Correct	Partial	Incorrect	Correct	Partial	Incorrect	Correct	Partial	Incorrect
IsiZulu	Group 1	0	0	10	0	2	8	0	1	9	3	0	7
Sesotho		0	0	10	2	5	3	3	0	7	3	1	6
Tshivenda		0	0	10	4	4	2	4	0	6	6	0	4
Total Mean		**0**	**0**	**10**	**3**	**4**	**4**	**2**	**0**	**7**	**4**	**0**	**6**
IsiZulu	Group 2	7	0	3	3	5	2	3	2	5	3	0	7
Sesotho		4	0	6	6	3	1	4	0	6	7	1	2
Tshivenda		1	0	9	3	5	2	6	0	4	6	2	2
Total Mean		**4**	**0**	**6**	**4**	**4**	**2**	**4**	**1**	**5**	**5**	**1**	**4**

Table 25 shows the total mean number of response accuracy in all the explanation types in all the three language groups across age. As this table demonstrates, the mean number of correct responses in all the explanation types increases with age. Group 2 participants across the language groups produced more correct responses in all the explanation types than the group 1 participants. Furthermore, group 2 participants across the language groups produced fewer incorrect responses in all the explanation types than group 1 participants. This means that the number of incorrect responses in all these explanation types decrease as children become mature.

Hypothesis Formulation Explanation Responses

In the Hypothesis Formulation explanation type, as the above table demonstrates, group 2 participants produced the highest mean number of correct responses compared to the group 1 participants, who did not have any correct responses. This shows that the number of correct responses increases as children grow older. Furthermore, the table shows that group 1 participants produced the highest mean number of incorrect responses compared to group 2 participants, who produced fewer incorrect responses. This shows that the number of incorrect responses decreases in this explanation type as children grow older.

As seen in table 25, in the isiZulu group, the number of correct responses increases. Group 2 participants in this language group had a higher number of correct responses in the Hypothesis Formulation explanation, and group 1 participants did not have any correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

This is also evident in the Sesotho group. As table 25 shows, in the Sesotho group, the number of correct responses increases. Group 2 participants in this language group also had a higher number of correct responses in the Hypothesis Formulation explanation, and group 1 participants did not have any correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

The Tshivenda group also shows the same trend as both isiZulu and Sesotho groups. As the table above reveals, in the Tshivenda group, the number of correct responses increases. Group 2 participants in this language group had a higher number of correct responses in the Hypothesis Formulation explanation, and group 1 participants did not have correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. Even in this language group, this means that as children grow older, the number of correct responses increases while the number of incorrect responses decreases.

All the age groups in all these three language groups did not produce any partially correct responses.

Procedural Explanation Responses

In the Procedural explanation type, group 2 participants produced the highest mean number of correct responses compared to the group 1 participants, who produced fewer correct responses. This shows that the number of correct responses increases as children grow older. Furthermore, group 1 participants produced the highest mean number of incorrect responses compared to group 2 participants, who produced fewer incorrect responses. This shows that the number of incorrect responses decreases in this explanation type as children grow older.

As table 25 shows, in the isiZulu group, the number of correct responses increases. Group 2 participants in this language group had a higher number of correct responses in the Procedural explanation, and group 1 participants did not have any correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

This is also evident in the Sesotho group. As seen in the table, in the Sesotho group, the number of responses increases. Group 2 participants in this language group also had a higher number of correct responses in the Procedural explanation, and group 1 participants only had fewer correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

In contrast, the Tshivenda group did not show a similar trend observed in both the isiZulu and Sesotho groups. As table 25 shows, in the Tshivenda group, group 1 participants produced a higher number of correct responses than group 2 participants in the Procedural explanation. This means that the number of correct responses decreases, contrary to what was observed in both isiZulu and Sesotho groups. In analysing the number of incorrect responses in this language group, both group 1 and group 2 participants had a similar number of incorrect responses in this explanation. Even in the number of incorrect responses, this language group does not follow the same trend observed in the other two language groups.

All the age group in all these language groups produced partially correct responses, and this increases with age in both the isiZulu and Tshivenda groups. Contrary to this, partially correct responses in the Sesotho group decreases with age. This means group 1 participants had more partially correct responses than group 2 participants. This is not case in the other two language groups which show that group 2 participants had more partially correct responses than group 1 participants.

Theory of Mind Explanation Responses

In the Theory of Mind explanation type, as table 25 demonstrates, group 2 participants produced the highest mean number of correct responses compared to the group 1 participants, who produced fewer correct responses across all the language groups. This shows that the number of correct responses increases as children grow older. Furthermore, group 1 participants produced the highest mean number of incorrect responses compared to group 2 participants, who produced fewer incorrect responses across all the language groups. This shows that the number of incorrect responses decreases in this explanation type as children grow older.

As table 25 above demonstrates, in the isiZulu group, the number of correct responses increases. Group 2 participants in this language group had a higher number of correct responses in the Theory of Mind explanation, and group 1 participants did not have any correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

This is also evident in the Sesotho group. As seen in the above table, in the Sesotho group, the number of correct responses increases. Group 2 participants in this language group also had a

higher number of correct responses in the Theory of Mind explanation, and group 1 participants only had fewer correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

The Tshivenda group also shows the same trend as both isiZulu and Sesotho groups in this explanation type. In the language group, the number of correct responses increases. Group 2 participants in this language group had a higher number of correct responses in the Theory of Mind explanation type, and group 1 participants did not have correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. Even in this language group, this means that as children grow older, the number of correct responses increases while the number of incorrect responses decreases.

In this type of explanation, only age groups in the isiZulu group produced partially correct responses, and this increases with age. This means group 2 participants produced more partially correct responses than group 1 participants in this explanation type.

Causal Explanation Responses

Finally, in the Causal explanation type, as the table above reveals, group 2 participants produced the highest mean number of correct responses compared to the group 1 participants, who produced fewer correct responses across all the language groups. This shows that the number of correct responses increases as children grow older. Furthermore, group 1 participants produced the highest mean number of incorrect responses compared to group 2 participants, who produced fewer incorrect responses across all the language groups. This shows that the number of incorrect responses decreases in this explanation type as children grow older.

As table 25 reveals, in the isiZulu group, the number of correct responses is the same in both age groups. This means that both group 1 and group 2 participants had the same number of correct responses in the Causal explanation type. In analysing the number of incorrect responses in this language group, both age groups had the same number. This means that both age groups had the same number of incorrect responses in this explanation type.

In the Sesotho group, we note a different trend from that one observed in the isiZulu group. Table 25 shows that in this language group, the number of correct responses increases. Group 2 participants in this language group had a higher number of correct responses in the Causal explanation type, and group 1 participants had fewer correct responses in this explanation type. In analysing the number of incorrect responses in this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses. This means that as children grow older in this language group, the number of correct responses increases while the number of incorrect responses decreases.

In the Tshivenda group, we note a similar trend that was observed in the isiZulu group in terms of correct responses. As seen in the table, in this language group, both group 1 and group 2 participants produced the same number of correct responses in this explanation type. In the analysis of incorrect responses, we note that the trend is the same as the one observed in the Sesotho group. In this language group, group 1 participants had a higher number of incorrect responses and group 2 participants had fewer incorrect responses.

In this explanation type, both age groups produced a similar number of partially correct responses in the Sesotho group. In the Tshivenda group, this is only observed in group 2 participants, indicating a development in responding to this question accurately.

Overall, as table 25 reveals, the number of correct responses in all the explanation types increase with age. Group 2 participants had more correct responses than group 1 participants. Furthermore, group 2 participants had fewer incorrect responses than group 1 participants. This trend is observed in the Hypothesis Formulation explanation type where group 2 participants had more correct responses than group 1 participants, and where group 2 participants had fewer incorrect responses than group 1 participants in all the language groups. Furthermore, in the Procedural explanation, this trend is only observed in both the isiZulu and Sesotho groups. In the Tshivenda group, group 1 participants had more correct responses than group 2 participants, and both age groups had a similar number of incorrect responses. In the Theory of Mind explanation, there is a similar trend that is observed in the Hypothesis Formulation explanation. As children grow older, the number of correct responses increases while the number of incorrect responses decreases.

In the Causal explanation, both age groups produced the same number of correct responses and incorrect responses in the isiZulu group. In the Sesotho group, contrary, the number of correct responses increases, and the number of incorrect responses decreases in group 2 participants.

Lastly, in the Tshivenda group, both age groups produced the same number of correct responses. A similar trend is observed where group 2 participants produced fewer incorrect responses than group 1 participants.

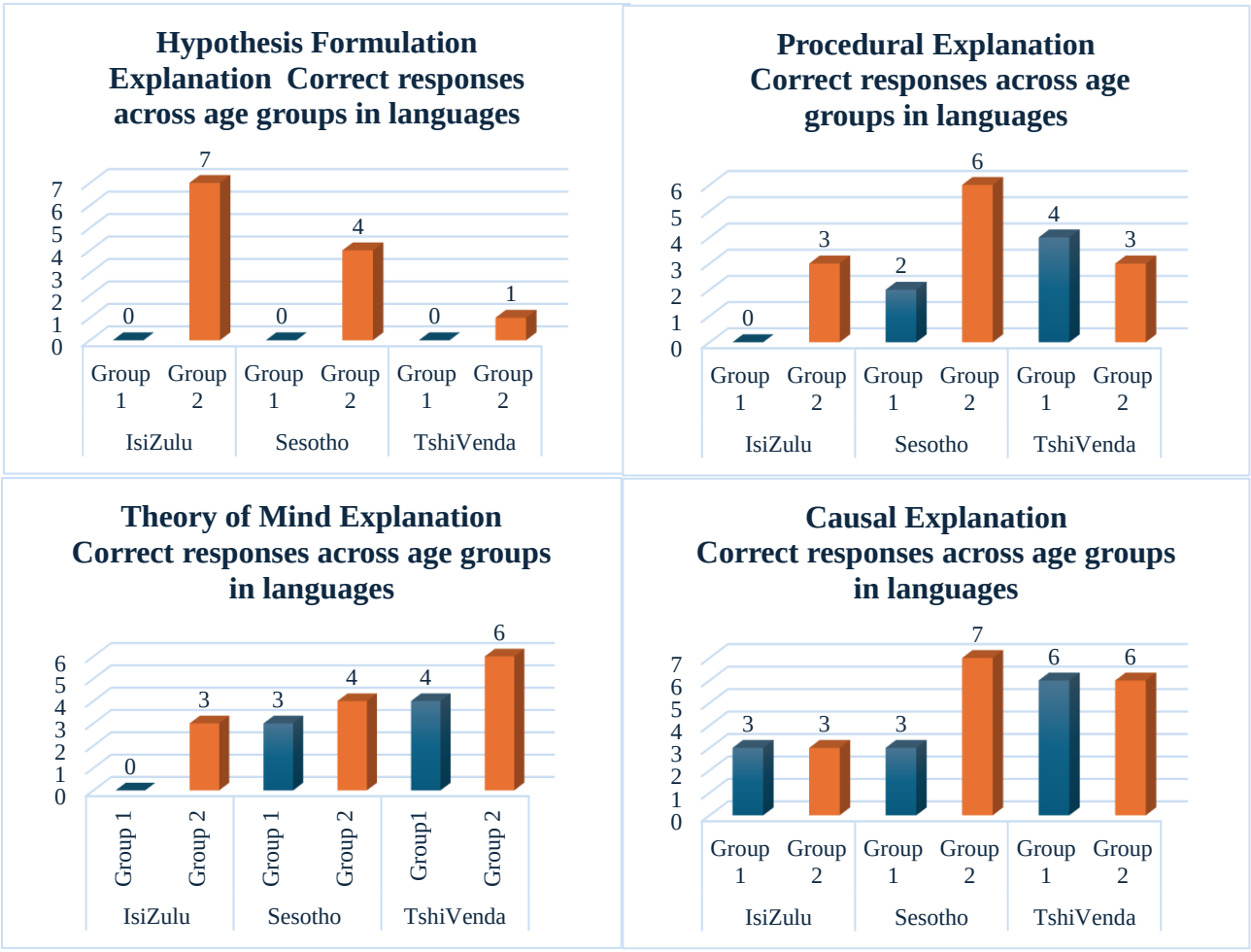


Figure 10: Correct responses per explanation type across age groups in languages

As figure 10 highlights, in both age groups in all the three language groups, there is a development in the ability to produce correct responses across explanation types. As children mature, they become proficient in providing accurate responses, with the number of correct responses increasing across all explanation types. The figure shows that this is the case in all the explanation types, with the exception of Procedural explanation in the Tshivenda group. As analysis in figure 10 shows the younger age group provided more Procedural explanations than the older age group. Overall, this figure demonstrates that the development of explanatory skills is a continuous process that progresses over time, with children becoming more adept at producing and articulating explanations as they age.

In our analysis, we subsequently performed a Mann-Whitney test, and this indicated that, out of the four explanation types, there was no significant difference in the response accuracy in the Theory of Mind explanation, and Causal explanation across the age groups in the three languages. A significant difference was observed in both the Hypothesis Formulation and Procedural explanation types. The results are shown below.

Table 26: Mean rank number of the response accuracy in the Hypothesis Formulation and Procedural explanation types across age groups

	Age Groups	*Num. of participants*	*Mean Rank*
Hypothesis Formulation Explanation	Group 1	30	24,50
	Group 2	30	36,50
Procedural Explanation	Group 1	30	25,60
	Group 2	30	35,40

The Mann-Whitney test results in table 27 indicated that there was a significant difference in the response accuracy in the Hypothesis Formulation explanation across the two age groups in the three languages, p = [<.001]. This shows that there are differences in the response accuracy across the two age groups. Table 27 shows group 2 had the highest mean rank number of the response accuracy of [36.50] in the Hypothesis Formulation explanation. Group 1 had the lowest mean rank number of the response accuracy of [24.50] in this explanation type.

The Mann-Whitney test also demonstrated that there was a significant difference in the response accuracy in the Procedural explanation across the two age groups in the three languages, p = [.021]. This shows that there are differences in the response accuracy across the two age groups. The table above shows group 2 had the highest mean rank number of the response accuracy of [35.40] in the Procedural explanation. Group 1 had the lowest mean rank number of the response accuracy of [25.60] in this explanation type.

4.2.5 Gesture Analysis

As stated above, gesture plays an imperative role in the development of language. The means by which children communicate go beyond their verbal expressions; gestures, too, provide valuable insights into their language acquisition process. Here, we analysed gesture across the two age groups in the three language groups. For the analysis of gesture, only bodily movements that maintained a relation to speech were coded (co-speech gesture). These were exported from ELAN to Excel and SPSS for a quantitative analysis. In this chapter, gestures strokes, gesture functions, and semantic relations were analysed.

Gesture Stroke

Meaningful parts of the gesture i.e., the strokes were analysed. Here, we looked at the production of gesture in each explanation type. The table below shows the results that were obtained.

Table 27: Mean number of gestures per explanation type across age groups in languages

Languages	Age groups	Explanation types			
		Hypothesis Formulation Explanation	**Procedural Explanation**	**Theory of Mind Explanation**	**Causal Explanation**
IsiZulu	Group 1	0	1	0	0
Sesotho		3	3	1	1
Tshivenda		1	0	0	1
Total Mean		**4**	**4**	**1**	**2**
IsiZulu	Group 2	0	1	0	0
Sesotho		1	6	2	0
Tshivenda		1	0	0	0
Total Mean		**2**	**7**	**2**	**0**

Table 27 shows the mean number of gestures per explanation type across age groups in all the language groups. As the table demonstrates, the mean number of gestures in both the Hypothesis Formulation and Causal explanation type decreases and increases in both the Procedural and Theory of Mind explanation types. Overall, group 2 participants in both Hypothesis Formulation and Causal explanation types gestured less than group 1 participants. In contrast, group 2 participants in both Procedural and Theory of Mind explanation types gestured more than group 1 participants.

Hypothesis Formulation Explanation

In the Hypothesis Formulation explanation type, as the table shows, group 1 participants produced more gestures than group 2 participants. This shows that the mean number of gestures

decreased with age in this explanation type. The table shows that in the isiZulu group, both group 1 and group 2 participants did not produce any gestures in this explanation type. In analysing the Sesotho group, table 27 demonstrates that group 1 participants produced more gestures than group 2 participants in the Hypothesis Formulation explanation type. This means that the number of gestures decreased with age in this language group. Lastly, in the Tshivenda group, both age groups produced a similar mean number of gestures in this explanation type. The table further shows the Sesotho group produced more gestures than both the isiZulu and Tshivenda groups in group 1. The Tshivenda group produced more gestures than the isiZulu group in this age group. In group 2, both the Sesotho and Tshivenda groups produced a similar mean number of gestures, higher than the isiZulu group which did not produce any.

Procedural Explanation

In the Procedural explanation type, as seen in the above table, group 2 participants produced more gestures than group 1 participants. This shows that the mean number of gestures increased with age in this explanation type. The table shows that in the isiZulu group, both group 1 and group 2 participants produced a similar number of gestures in this explanation type. In analysing the Sesotho group, the table reveals that group 2 participants produced more gestures than group 1 participants in the Procedural explanation type. Lastly, in the Tshivenda group, both group 1 and group 2 participants did not produce any gestures. Table 27 further shows that in both group 1 and group 2, the Sesotho group produced more gestures than the other two language groups. The isiZulu group produced more gestures than the Tshivenda group in both age groups.

Theory of Mind Explanation

In the Theory of Mind explanation type, as the above table reveals, group 2 participants produced more gestures than group 1 participants. This shows that the mean number of gestures increased with age. The table shows that in the isiZulu group, both group 1 and group 2 participants did not produce any gestures in this explanation type. In analysing the Sesotho group, group 2 participants produced more gestures than group 1 participants in the Theory of Mind explanation. Lastly, in the Tshivenda group, both group 1 and group 2 participants did not produce any gestures. The table further shows that in both group 1 and group 2, the Sesotho group produced more gestures than the other two language groups. Furthermore, both the isiZulu and Tshivenda groups did not produce any gestures in both group 1 and group 2.

Causal Explanation

Finally, in the Causal explanation type, as table 27 above shows, group 1 participants produced more gestures than group 2 participants. This shows that the mean number of gestures decreased with age in this explanation type. The table shows that in the isiZulu group, both group 1 and group 2 participants did not produce any gestures in this explanation type. In analysing the Sesotho group, group 1 participants produced more gestures than group 2 participants, who did not produce any gestures in this explanation type. This means that the number of gestures decreased with age in this language group. Lastly, in the Tshivenda group, we observe a similar trend as the one in the Sesotho group. Group 1 participants produced more gestures than group 2 participants in this language group in the Causal explanation type.

Overall, as the table demonstrates, group 1 and group 2 participants in the isiZulu group had an equal mean number of gestures in all four explanation types. The gestures were only present in the Procedural explanation type. There were no gestures in the other three explanation types in both age groups in this language group. In the Sesotho group, the table reveals that group 1 participants had more gestures in the Hypothesis Formulation and Causal explanations than group 2 participants. This indicates that group 1 participants in this language group gestured more when formulating a hypothesis and causality or causation explanations than the group 2 participants. Group 2 participants had more gestures in the Procedural and Theory of Mind explanations than the group 1 participants in this language group. This indicates that group 2 participants in this language group gestured more when explaining a step-by-step process and mental states of others than the group 1 participants. Lastly, in the Tshivenda group, the table indicates that group 1 and group 2 participants had an equal mean number of gestures in three explanation types (Hypothesis Formulation, Procedural, and Theory of Mind explanations). In the Causal explanation, group 1 participants had more gestures than group 2 participants. This indicates that group 1 participants gestured more when producing causation or causality explanations than group 2 participants in this language group.

In our analysis, we subsequently performed a Mann-Whitney test, and this indicated that, out of the four explanation types, there was no significant difference in the production of gestures in Procedural and Theory of Mind explanations across the two age groups. A statistical difference was only observed in the Hypothesis Formulation and Causal explanation types. The results are shown in Table 28.

Table 28: Mean rank number of gesture production in the Hypothesis Formulation and Causal explanation types across age

	Age Groups	*Num. of participants*	*Mean Rank*
Hypothesis Formulation	Group 1	30	35,83
	Group 2	30	25,17
Causal Explanation	Group 1	30	34,35
	Group 2	30	26,65

Table 28 shows that there was a significant difference in the production of gestures in the Hypothesis Formulation explanation across the two age groups in the three language groups, p = [.008]. Table 28 shows that group 1 participants had the highest mean rank number of gestures [35.83] in the Hypothesis Formulation explanation. Group 2 participants had the lowest mean rank number of gestures [25.17] in this type of explanation. These results indicate that group 1 participants in this type of explanation gestured more than group 2 participants.

The test also indicated that there was a significant difference in the production of gestures in the Causal explanation across the two age groups in the three language groups, p = [.021]. Table 28 shows that group 1 participants had the highest mean rank number of gestures [34.35] in the Causal explanation. Group 2 participants had the lowest mean rank number of gestures [26.65] in this type of explanation. These results indicate that group 1 participants in this type of explanation gestured more than group 2 participants.

Gesture Functions

The study now aims to look at the functions of the gesture that has been explored above. This means that the co-speech body movements that were identified as gestures were described and classified according to their functions. There were only a few of gestures and mostly were representational, performative and discursive gestures. Table 29 shows the results that were obtained.

Table 29: Mean number of gesture functions across age groups in languages

Languages	Age groups	Gesture Functions		
		Representational	Performative	Discursive
IsiZulu	Group 1	1	1	0
Sesotho		4	3	1
Tshivenda		0	2	0
Total Mean		**5**	**6**	**1**
IsiZulu	Group 2	1	0	0
Sesotho		5	0	2
Tshivenda		0	0	1
Total Mean		**6**	**0**	**3**

As table 29 demonstrates, out of all the gesture functions produced, the highest occurring gesture function was the representational gesture function. This was followed by the performative gesture function. The performative gesture function coming second is normal owing to the nature of the task of explaining, which is mostly dialogic. The least occurring gesture functions are discursive gestures. Furthermore, as it is noted in the table, group 2 participants produced the highest mean number of representational gestures compared to group 1 participants. In performative gestures, group 1 participants produced more than group 2 participants, who did not produce any performative gestures. Lastly, group 2 participants produced more discursive gestures than group 1 participants.

Representational

As seen in the table above, group 2 participants produced more representational gestures than group 1 participants. This shows that the mean number of representational gestures increased with age. Furthermore, this shows that group 2 participants represented their explanations with gestures more than group 1 participants. In the isiZulu group, both group 1 and group 2 participants had a similar mean number of representational gestures. In the Sesotho group, group 2 participants produced more representational gestures than group 1 participants, indicating that the older group represented their explanation with more gestures than group 1 participants in this language group. Lastly, in the Tshivenda group, both group 1 and group 2 participants did not produce any representational gestures. In this gesture function, group 1 participants in the Sesotho group produced more representational gestures than other group 1 participants in the other two language groups. Group 1 participants in the isiZulu group produced more representational gestures than group 1 participants in the Tshivenda group. This trend is similar even in the group 2 age group.

Performative

As table 29 shows, group 1 participants produced more performative gestures than group 2 participants. This shows that the mean number of performative gestures decreased with age. Furthermore, this shows that group 1 participants performed their explanations with gestures such as nodding or shaking of the head more than group 2 participants did. In the isiZulu group, group 1 participants produced more performative gestures than group 2 participants, who did not produce any. In the Sesotho group, we note a similar trend. Group 1 participants produced more performative gestures than group 2 participants, who did not produce any gestures in this language group. Lastly, in the Tshivenda group, we note a similar trend as observed in the other two language groups. Group 1 participants produced more performative gestures than group 2 participants, who did not produce any gestures in this language group. In this gesture function, group 1 participants in the Sesotho group produced more performative gestures than other group 1 participants in the other two language groups. Group 1 participants in the Tshivenda group produced more performative gestures than group 1 participants in the isiZulu group. In the group 2 age group, none of the three language groups produced any performative gestures.

Discursive

Finally, as noted in table 29, group 2 participants produced more discursive gestures than group 1 participants. This shows that the mean number of discursive gestures increased with age. Furthermore, this shows that group 2 participants used rhythmic movements of the hand or head accompanying certain syllables or words in their explanations more than group 1 participants. In the isiZulu group, both group 1 and group 2 participants did not produce any discursive gestures. In the Sesotho group, group 2 participants produced more discursive gestures than group 1 participants, indicating that group 2 participants used more discursive gestures in their explanations than group 1 participants in this language group. Lastly, in the Tshivenda group, group 2 participants produced more discursive gestures than group 1 participants, who did not produce any. In this gesture function, only group 1 participants in the Sesotho group produced discursive gestures. Group 2 participants in the Sesotho group produced more discursive gestures than other group 2 participants in the other language group. Group 2 participants in the Tshivenda group produced more discursive gestures than group 2 participants in the isiZulu group, who did not produce any discursive gestures.

Overall, as seen in table 29, there are more representational gestures, and these gestures increases with age. Furthermore, only group 1 participants in all the language groups produced performative gestures. These gestures are not present in the group 2 age group. This shows that

performative gestures decreased with age. Lastly, discursive gestures show a similar trend observed in representational gestures. There are more discursive gestures in the older group than in the younger group. This indicates that discursive gestures increased with age.

In our analysis, we subsequently performed a Mann-Whitney test, and this indicated that, out of the three produced gesture functions, there was no significant difference in the representational and discursive gesture functions. A significant difference was observed in the performative gesture function. Table 30 shows this result.

Table 30: Mean rank number of gesture functions across age

	Age Groups	*Num. of participants*	*Mean Rank*
Performative	Group 1	30	36,07
	Group 2	30	24,93

Table 30 shows the Mann-Whitney test results, and this indicates that there was a significant difference in the performative gesture function across age in the language groups, p = [.006]. The result shows that for this gesture function, group 1 participants produced the highest mean rank number of [36.07], and group 2 participants produced the lowest mean rank number of [24.93].

Semantic Relations

We subsequently looked at the relationship that gestures have to verbal content. This means that we looked at the relationship that gestures have to the produced explanations. These gestures were coded as reinforcing, supplementing, complementing, integrating, substituting, or contradictory. In our data, there were no semantic relations that were complementary, contradictory, and substituted to speech. This study, therefore, only analysed gestures that reinforced, integrated, and supplemented the verbal content. Table 31 shows the results.

Table 31: Mean number of supplementary, integrating, and reinforcing semantic relations across age in the languages groups

Languages	Age groups	Semantic Relations		
		Supplements	Integrates	Reinforces
IsiZulu	Group 1	1	1	0
Sesotho		4	3	1
Tshivenda		1	0	0
Total Mean		**6**	**4**	**1**
IsiZulu	Group 2	0	1	0
Sesotho		2	4	3
Tshivenda		1	0	1
Total Mean		**3**	**5**	**4**

As noted in table 31, out of all the semantic relations produced, the highest occurring one was both the supplementary and integrating semantic relations with a similar mean number. Reinforcing gestures were infrequent. Furthermore, it is also noted in this table that group 1 participants produced the highest mean number of supplementary gestures compared to group 2 participants. In integrating gestures, group 2 participants produced more than group 1 participants. Lastly, group 2 participants produced more reinforcing gestures than group 1 participants.

Supplements

As observed in table 31, group 1 participants produced more supplementary gestures than group 2 participants. This shows that supplementary gestures decreased with age. This means that group 1 participants had more gestures that added new information that was not coded in their explanations than group 2 participants. In the isiZulu group, group 1 participants produced more supplementary gestures than group 2 participants. This is also evident in the Sesotho group. In this language group, group 1 participants produced more supplementary gestures than group 2 participants, indicating younger children added new information through gestures that was not coded in their explanation more than older children. Lastly, in the Tshivenda group, both group 1 and group 2 participants had a similar mean number of supplementary gestures. In this semantic relation, group 1 participants in the Sesotho group produced more supplementary gestures than other group 1 participants in the other two language groups. Group 1 participants in both the isiZulu and Tshivenda group produced a similar mean number of supplementary gestures. In the group 2 age group, the Sesotho group produced more supplementary gestures than the other two language groups. The Tshivenda group produced

more supplementary gestures than the isiZulu group, which did not produce any supplementary gestures in this age group.

Integrates

As table 31 shows, group 2 participants produced more integrating gestures than group 1 participants. This shows that integrating gestures increased with age. This means that group 2 participants used gestures that added precision to their explanations more than group 1 participants. In the isiZulu group, both group 1 and group 2 participants had a similar mean number of integrating gestures. In this Sesotho group, group 2 participants produced more integrating gestures than group 1 participants, indicating that older children used more gestures that added precision to their explanations than group 1 participants in this language group. Lastly, in the Tshivenda group, both group 1 and group 2 participants did not produce any integrating gestures. In this semantic relation, group 1 participants in the Sesotho group produced more integrating gestures than other group 1 participants in the other two language group. Group 1 participants in the isiZulu group produced more integrating gestures than other group 1 participants in the Tshivenda group. The Tshivenda group 1 participants did not produce any integrating gestures. In the group 2 age group, the same trend is observed.

Reinforces

Finally, as noted in the above table, group 2 participants produced more reinforcing gestures than group 1 participants. This shows that reinforcing gestures increased with age. This means that group 2 participants had more gestures that refined their explanations than group 1 participants. In the isiZulu group, both group 1 and group 2 participants did not produce any reinforcing gestures. Contrary to this, in the Sesotho group, group 2 participants produced more reinforcing gestures than group 1 participants, indicating that older children refined their explanations with gestures more than group 1 participants in this language group. This is also evident in the Tshivenda group. In this language group, group 2 participants produced more reinforcing gestures than group 1 participants. In this semantic relation, group 1 participants in the Sesotho group produced more reinforcing gestures than other group 1 participants in the other two language groups. Group 1 participants in both the isiZulu and Tshivenda groups did not produce any reinforcing gestures. In the group 2 age group, the Sesotho group produced more reinforcing gestures than the other two language groups. The Tshivenda group produced more reinforcing gestures than the isiZulu group, which did not produce any reinforcing gestures in this age group.

Overall, as observed in table 31 above, there more supplementary and integrating gestures. Supplementary gestures decrease with age while integrating gestures increase. The table reveals that the Sesotho group achieved the highest mean number in all three sematic relations in both group 1 and group 2 ages. Reinforcing gestures increase with age, indicating a similar trend observed in the integrating gestures. This means that group 2 participants produced more gestures than group 1 participants.

Subsequently, a statistical Mann-Whitney test was performed, and this indicated that there was no significant difference in the production of gestures that reinforced, integrated, or supplemented meaning to the produced explanations across the two age groups in the three languages.

4.3 Chapter Summary

The quantitative analysis presented in this section concludes with several key observations and findings. This section explored the development of explanatory skills during late language acquisition in children that speak South African Bantu languages – isiZulu, Sesotho, and Tshivenda. The study began with the speech analysis. It is noted that there is a variation in the performance of explanations across the explored languages. This is observed in terms of the amount of information that was given in the explanatory length. When looking at the Tshivenda group, we note that this group was able to summarise their explanations, followed by the isiZulu group, and lastly, the Sesotho group. The study, furthermore, analysed the development of pragmatics in assessing the establishment of explanatory skill.

The results of this analysis further showed that all the language groups preferred to generate detailed explanation in the Procedural. Other explanation types show a lower mean number of clauses compared to the Procedural explanation type across all the language groups, suggesting that participants gave fewer clauses in them. Interestingly, when observing explanation responses in all the languages, we noted that there are less incorrect responses in the Procedural explanations, suggesting that when participants give more clauses, they are less likely to get incorrect responses. More correct responses are observed in the Causal explanation. There were less clauses that were produced in this explanation type when compared to other explanation types. When observing the gesture results across all the language group, we note that the Sesotho group produced more gestures in all the explanation types than the other two language group.

When looking the findings of the age groups, the analysis revealed that there are differences in explanatory performances across age in all the language groups. This is also observed in terms of the amount of information that was given in the explanatory length – group 2 participants provided shorter explanations with fewer clauses whereas the group 1 participants provided longer explanations with more clauses. When looking at the pragmatic acts, there is an increase in the number of explaining pragmatic acts, with the younger age group providing fewer explaining pragmatic acts and the older age group providing more explaining pragmatic acts.

The results of this analysis further showed that participants across age groups preferred to give detailed explanations in the Procedural. Other explanation types show a lower mean number of clauses, suggesting that participants gave fewer clauses in them. Interestingly, when observing the explanation responses, we note older children produced more correct responses than the

younger children. Furthermore, Group 2 participants across the language groups produced fewer incorrect responses in all the explanation types than group 1 participants.

In analysing the gesture results across the age groups in all the language group, we note that the younger group produced more gestures in both the Hypothesis Formulation and Causal explanation types than the older group. The older group produced more gestures in both the Procedural and Theory of Mind explanations. These results show that there is a downward trend in both the Hypothesis Formulation and Causal explanation types, and an increase trend in both the Procedural and Theory of Mind explanation. The results further show that there is a developmental trajectory in the ability to produce gestures that represent and those that structure speech and highlight linguistic units.

Chapter 5 – Discussion and Conclusion

The aim of this dissertation was to study the development of explanations during late language acquisition in three South African Bantu languages, isiZulu, Sesotho, and Tshivenda, from a multimodal perspective. Most of the studies that exist study the oral narrative communicative task from a multimodal perspective (Kunene Nicolas 2015, 2010; Colletta et al., 2010; Colletta, 2009; amongst others). The study sought to look at explanations in particular, - how children respond when asked a question in order to investigate how knowledge and information is processed. We also investigated whether there was a developmental effect on explanatory skills. This development was observed by analysing the speech and gestural behaviour of the participants during a language production task of the oral explanations. The study consisted of 60 children, all of whom were native speakers of one of the three languages under investigation. Of these 60 participants, 20 children spoke each of the three languages, with equal representation across age groups (5–6 years old and 9–10 years old). Therefore, the study consisted of a total of 30 children in each age group, with 10 children in each age group speaking one of the three languages. These age ranges were selected owing to the developmental milestones that children go through (Alamillo et al., 2013).

The study employed a methodology developed by Colletta et al., (2009, 2015), and this was used to elicit oral explanations from participants. Participants were shown a wordless cartoon and the asked four questions in order to elicit explanations from them. Each question aimed to elicit a specific explanation. For instance, in order to elicit a Hypothesis Formulation explanation, participants were asked a Hypothesis Formulation question. The analysis first examined the production of explanation by speakers of isiZulu, Sesotho, and Tshivenda from a multimodal perspective. This analysis sought to understand how speakers of these languages produce multimodal explanations. The second part of our analysis investigated if there is an effect of age on the multimodal explanatory skills in isiZulu, Sesotho, and Tshivenda.

The research questions of the study are reiterated below:

1. In what ways do speakers of isiZulu, Sesotho, and Tshivenda create multimodal explanations?
2. How does age influence the multimodal explanatory abilities of speakers in isiZulu, Sesotho, and Tshivenda?

In our analysis, our result showed that the length of the explanations of the Sesotho group was higher than that of the two other languages, with a significant difference between the Sesotho

and the Tshivenda group. The Sesotho group speakers tended to produce more narrative like explanation. While both the isiZulu and Tshivenda groups also displayed a trend to narrate during the explanatory communicative task, the frequency and intensity of this behaviour were not as frequent as with the Sesotho group. Our results further showed that, with age, the length of the children's explanations decreased. This result is consistent with the narrative literature where older children produce fewer clauses than younger children (Kunene Nicolas 2010, 2015; Colletta & Pellenq, 2009; amongst others). While older children produced fewer clauses in this communicative task, young children tended to narrate instead of to explain, and this increased their clause count.

To further analyse the explanations that were produced, we looked at the number of pragmatic acts produced by these language groups and two age groups. Our results showed that there were more narrating pragmatic acts than other pragmatic acts in this explanatory task. The Sesotho group produced more narrating pragmatic acts than the other two language groups. Furthermore, the results showed that in the explaining pragmatic act, the Tshivenda group produced the highest number than the other two language groups. These results show that speakers in the Tshivenda group preferred to stick more to the explaining pragmatic act in line with the demands of the task in comparison to the other two language groups. A significant difference was observed in both the narrating and explaining pragmatic act across the three language groups. In line with the different pragmatic acts being dominant in different languages, we can presume that different linguistic and cultural factors may have influence over the use of narrating as a communicative strategy across the three language groups.

In analysing the two age groups, the results showed that the younger group produced more narrating pragmatic acts compared to the older group. In their study, Colletta (2004) and Kunene Nicolas (2010) stated that a more complex discourse would be shown by an increase of non-narrative pragmatic acts (explaining, interpreting, and commenting). In our study, the results showed that older children produced more explaining pragmatic acts compared to the younger children with a significant difference. Since this is an explanation elicitation study, we expected older children to produce more explaining pragmatic acts than the younger children. These results show that children in these two age groups are capable of producing explanations, but they tended to narrate more in this study. In the view of Hempel and Oppenheim (1948), explanations consist of two key components: the *explanandum* (the phenomenon requiring explanation) and the *explanans* (the causal factors, reasons, or motivations underlying the

phenomenon or behaviour). Our results appear to diverge from this definition, as the participating children predominantly adopted a narrative strategy in their explanations.

The number of clauses in each type of explanation and response accuracy was investigated. The four types of explanations were Hypothesis Formulation, Procedural, Theory of Mind, and Causal explanation and they were investigated in terms of language and development.

Hypothesis Formulation Explanation

For this type of explanation, we sought to encourage participants to think critically about a problem or phenomenon and to generate possible explanations based on their understanding of the world. Furthermore, the question that aimed to elicit this type of explanation sought to make participants reflect on the causes or underlying reasons behind a specific event or outcome. It required them to think beyond the surface level of what they observed and consider the different factors that may have contributed to the result.

Looking at our findings for the Hypothesis Formulation explanations, we observed that the Sesotho group had longer explanations, using more clauses than the other language groups. This suggests that the Sesotho group gave more detailed explanations compared to the isiZulu and Tshivenda groups. However, we also found that most of the responses were inaccurate across all language groups for the Hypothesis Formulation explanation, with the Tshivenda group having the highest number of correct responses, followed by the Sesotho group, and finally, the isiZulu group. Interestingly, these results reveal that the number of clauses in these language groups may not necessarily correlate with the accuracy of this explanation type. In other words, longer Hypothesis Formulation explanation type does not always mean more accurate explanations, which suggests that other factors may influence the quality of this explanation type. The results of this study further indicate that the question posed to elicit Hypothesis Formulation explanations may not have been culturally and linguistically appropriate for the Bantu language groups studied. This may explain why the responses did not adhere to our anticipated pattern, as the questions may not have been structured in a way that resonated with the linguistic and cultural norms of the participants.

The theoretical framework which was used as an underlying basis for our research is founded on research investigations that propose that gesture and language develop in the same place in the mind and these modalities are part of a single process (McNeill, 1992; Kita & Özyürek, 2003). Even though gestures were few in this study, making a quantitative analysis a challenge, we observed a variation in their production across the three language groups in this explanation

type. Notably, the Sesotho group produced more gestures than the isiZulu and Tshivenda groups. The Tshivenda group, while producing fewer gestures that the Sesotho group, still made more gestures than the isiZulu group, which did not produce any gestural communication in their responses. These results suggest a link between the explanatory discourse and the use of gestures. In particular, the language groups that produced longer explanations also tended to make more gestures, indicating that gestures may serve as a means of supporting communication and enhancing comprehension. This is supported by many gestures scholars who purport that gestures and languages stem from the same conceptual stage (Kita & Özyürek, 2003; Kunene Nicolas 2015; amongst others).

In our analysis of Hypothesis Formulation explanations, we found a noteworthy difference between the two age groups, with younger children (group 1) showing a greater tendency towards longer explanations, while older children (group 2) produced shorter and more clear explanations. This pattern suggests that younger children may find the process of constructing Hypothesis Formulation explanations more effortful, potentially requiring more effortful processing of linguistic and conceptual resources. In contrast, older children appear to have developed a greater fluency in this form of explanatory discourse, allowing them to generate more concise and efficient explanations. This result is in line with the oral narrative behaviour observed in children of these ages (Kunene Nicolas 2015; Colletta et al., 2015) who state that the master of concise information is a late development, as children grow older, their clauses become shorter. Based on these results, we can infer that older children have developed the use of more cohesive devices that allow the expression of information in concise and efficient manner without having to recount a lot of information for the Hypothesis Formulation explanations. Moreover, our findings indicate that the accuracy of Hypothesis Formulation explanation also increased with age, with older children producing more accurate responses and fewer incorrect ones than their younger counterparts. This suggests that explanatory skills, particularly those related to the formulation of hypotheses, develop and improve over time, likely owing to increase experience with explanatory discourse and the maturation of cognitive faculties.

Interestingly, our findings revealed that younger children (group 1) produced more gestures than their older counterparts (group 2) when producing Hypothesis Formulation explanations, regardless of the language group. This suggests a potential relationship between the use of gesture and explanatory discourse, with younger children who use more clauses in their

explanations also relying more on gestural communication. These results show that language and gesture are tightly related during childhood (Colletta et al., 2015; Kita & Özyürek, 2003; amongst others). As their language skills improve, the reliance on gesture decreases as they learn to express their hypotheses more effectively through speech.

Our findings are in agreement with previous research suggesting that children have the ability to formulate hypotheses in their explanatory discourse (Sodian et al., 2002; Gopnik, 2012; amongst others). Our results support the idea proposed by Gopnik (2012) that children are "scientists" in their explanatory behaviour, seeking to explain and understand the world around them. Other studies have further emphasised the scientific reasoning abilities of children, with Köksal-Tuncer and Sodian (2018) providing evidence that children from an early age have rudimentary scientific reasoning skills. In the light of these findings, we can infer that children's explanatory abilities share certain features and characteristics with scientific reasoning, suggesting a developmental trajectory that may eventually lead to more advanced explanatory and scientific thinking in adulthood.

Moreover, our results indicate that that the ability to produce Hypothesis Formulation explanations is not specific to any single language, as all three language groups in our study produced this ability. This finding suggests that this form of explanatory behaviour may be a universal component of human cognition, emerging across different linguistic and cultural contexts.

Procedural Explanation

In this explanation type, we sought to encourage participants to explain the specific procedures or steps that were involved in going to Jerry's house. The question that aimed to elicit this type of explanation sought to observe whether participants would be able to give a sequential explanation of steps or procedures in order to achieve a specific outcome or to understand a particular process. For this study, participants had to give a sequential explanation of how the egg arrived at Jerry's house.

Our findings for Procedural explanations revealed intriguing differences in both linguistic complexity and response accuracy across the three language groups. The Sesotho group produced a higher number of clauses in their explanations, indicating a tendency towards more detailed accounts of procedural information. The Sesotho group speakers may have interpreted the procedural question as a narrative task, prompting them to narrate the sequence of steps in detail and use more clauses to describe the process. This perception could have led to increased

wordiness in their procedural explanations compared to speakers of other languages who may have viewed the task as more straightforward and procedural in nature. This pattern of linguistic complexity was seen in the response accuracy of each language group, with the Sesotho group providing the highest number of correct responses. This suggests that, for Procedural explanations, a more detailed and comprehensive account of the steps required to achieve a desired outcome may result in a greater likelihood of producing a correct response.

The isiZulu group, which produced shorter explanations with fewer clauses, nonetheless demonstrated a higher number of correct responses than the Tshivenda group, suggesting that linguistic complexity is not the sole determinant of accuracy in Procedural explanations. We also note that cultural or educational factors may also play a role in shaping explanatory strategies and the ability to accurately convey procedural information. Furthermore, our results support the previous research of Rittle-Johnson et al., (2015), which assert that Procedural explanations often entail a more detailed and step-by-step account of to accurately convey procedural information. Our study suggests that this requirement for detail may show in higher number of clauses in explanatory-like-narratives, as observed in the Sesotho group.

Our results for the Procedural explanation type also revealed interesting patterns on the use of gestures across the three languages groups. The Sesotho group consistently produced more gestures in their explanations, followed by the isiZulu group, with the Tshivenda group using the fewest gestures. This suggests a potential relationship between language and gesture communication (Kita & Özyürek, 2003), with language groups that produced longer explanations also utilising more gestures. This finding aligns with the previous research on the relationship between language and gesture, which has suggested that gestures may serve as a supplement to language, aiding in the expression and comprehension of complex ideas (McNeill, 1992). The gesture use may be particularly beneficial in Procedural explanation where step-by-step procedures must be conveyed accurately. The significance of gestures in Procedural explanation is further strengthened by the finding that the Sesotho group, which produced both longer and more gestures, also demonstrated a higher degree of response accuracy in this explanation type.

Our findings reveal intriguing differences in both linguistic complexity and response accuracy across the two age groups for the Procedural explanation type, The younger children (group 1) produced longer explanations than their older counterparts (group 2), with a greater number of clauses in their procedural explanations. This pattern suggests that younger children may be

less focused on efficiency and more inclined towards providing comprehensive and detailed accounts, which could reflect a developmental stage in which children are still refining their explanatory skills. Furthermore, younger children produced more narrative-like explanations with increased clause complexity, which contributed to the higher number of clauses observed in their procedural explanations. This suggests that the younger children may have a greater tendency to provide narrative-like explanations when answering a procedural explanation, potentially owing to their developing language skills or their inclination towards storytelling. In contrast, older children (group 2) produce a more concise and efficient style of explanation, suggesting that they may have developed a greater proficiency in conveying procedural information with clarity and concision. The analysis of response accuracy further reinforces this developmental trend, with older children demonstrating a higher number of correct responses in Procedural explanations compared to younger children.

In addition to the difference in linguistic complexity and response accuracy, our analysis of gestures revealed another intriguing trend. Interestingly, group 2 participants (older children) used more gestures in their Procedural explanations than their younger counterparts in group 1, despite producing shorter and more concise explanations. Unlike in Hypothesis Formulation explanations, where younger children produced a greater number of gestures, in Procedural explanations, older children appeared to rely more on gestures as a reinforcing and integrating means of communication. This is interesting because older children produced more reinforcing and integrating gestures than their younger counterparts. These results suggest that gestures may play a supportive role in explaining complex procedural information, potentially serving to reinforce and clarify oral explanations.

Our results suggest that older children possess an enhanced ability to produce accurate and concise explanations. Even though there was no clear correlation between linguistic complexity and response accuracy across age groups, it is evident that older children have developed the skills needed to prioritise clarity and concision in their explanations, while younger children tend to focus on providing a more detailed, albeit potentially less accurate, account. These findings align with previous research suggesting that children possess procedural skills by school age (Rittle-Johnson & Alibali, 1999; Rittle-Johnson et al., 2001; Rittle-Johnson, 2017). Our findings further extend this previous research by demonstrating that children not only have procedural knowledge but are also able to produce Procedural explanations with improving accuracy. In addition to these findings on age-related differences, our results reinforce the

notion that Procedural explanations are not language-specific, with children from all three language groups demonstrating the ability to generate these explanations. This finding further underscores the universality of certain aspects of explanatory discourse, suggesting that certain types of explanations may develop similarly across different linguistic and cultural contexts. Gesture, as an important communicative modality, appears to interact with explanatory skills (Alamillo et al., 2013). It is possible that gestures serve different functions, with older children using them to reinforce and clarify their explanations.

Theory of Mind Explanation

For the Theory of Mind explanation, we sought to make the participant consider the thoughts and emotions of the baby bird, and to make inferences about why it was happy to see Jerry. The question asked sought to make the participant think about the baby bird's mental states, such as its desires and emotions, and to try to understand their motivations. In some sense, the question that was asked aimed to help the participant to better understand the emotions and motivations of others, and to develop their ability to put themselves in another person's shoes, which is an important aspect of theory of mind development (Wellman & Lagattuta, 2004; Wellman, 2011).

Our analysis of Theory of Mind explanations revealed notable variations in the length and complexity of the explanations across the three languages. The Sesotho group demonstrated an inclination towards producing longer explanations and employing a greater number of clauses in their explanatory accounts. By contrast, the isiZulu group produced shorter and more concise explanations, with fewest number of clauses across all the language groups. The Tshivenda group occupied the intermediate position, with a higher number of clauses than the isiZulu group but lower than the Sesotho group.

Interestingly, while the explanatory strategies employed by each language varied in complexity, our analysis of response accuracy revealed a difference in the distribution of accurate and inaccurate responses. Overall, there were more inaccurate responses than accurate responses across the three language groups. The isiZulu group produced a higher number of accurate responses than the other two language groups, suggesting that their more concise explanatory approach may have facilitated more accurate responses. Furthermore, we noted that participants in these language groups were able to achieve accurate responses because they were able to attribute the mental states and intentions to the both the baby bird and Jerry. We noted that there were several key explanatory strategies that they were able to employ to

achieve the accurate responses. The participants were able to make inferences about the character's intentions based on their behaviour. For instance, they were able to deduce that baby bird was happy to see Jerry because it thought it was its mother. The high number of inaccurate responses in these three languages could be because of the question design and wording. These could have played a crucial role in shaping the children's explanatory responses. While all the three languages in our study belong to the Bantu language family, they each have distinct syntactic structure, vocabulary, and cultural conventions. If the question was not culturally or linguistically appropriate for one or more of the language groups, it is possible that children may have struggled to comprehend or respond to it effectively, leading to a higher proportion of inaccurate responses.

Despite the high proportion of incorrect responses across all three language groups, the Sesotho group produced a higher number of gestures in their Theory of Mind explanations, while the isiZulu and Tshivenda groups did not produce any gestures. This finding suggests that even in the absence of correct responses, the Sesotho group speakers may have been using gestures as a tool to aid in the expression and comprehension of mental states and intentions. Although the Sesotho group's gestures may not have been directly related to the target response, they may have been using gestures as a means of integrating their explanatory discourse. This means that the gestures that were employed by this language group added precision to the information encoded in their Theory of Mind explanations. These results show that gesture serves as a way of signalling the speaker's intentions, cognitive process, and overall message (McNeill, 1992).

Our findings revealed a significant difference in the length of Theory of Mind explanations between the younger and older children. Group 1 participants (younger children) produced longer explanations, with more clauses, than their older counterparts in group 2. This pattern suggests that younger children may be more likely to adopt a detailed and comprehensive approach to Theory of Mind explanations, providing a richer account of the character's mental states and intentions. Conversely, the older children's explanations were more concise, which could reflect a greater focus on conveying their understanding of the character's mental states with greater clarity and precision.

Our results for response accuracy in Theory of Mind explanations suggest that this explanatory ability improves with age, as group 2 (older children) produced more correct responses than group 1 (younger children). Furthermore, in group 1, there were a higher number of incorrect responses, indicating that younger children may be less proficient in explaining mental states.

Our findings indicate that older children demonstrate greater proficiency in explaining mental states, with many employing the mental state attribution strategy to accurately explain why the baby bird was happy to see Jerry. The children's recognition that the baby bird's happiness was owing to its belief that Jerry was its mother demonstrates an advanced level of cognitive development and explanatory skill. In contrast, younger children produced a greater number of incorrect responses, suggesting that they may not have yet developed these explanatory strategies. However, it is also possible that the phrasing of the Theory of Mind question may have contributed to the difficulty younger children experienced in answering accurately.

Although Theory of Mind explanations were generally accompanied by fewer gestures across both age groups, group 2 participants (older children) produced a higher number of gestures than their younger counterparts in group 1. This finding is consistent with previous research suggesting that gesture production and usage tend to improve with age (McNeill, 1992).

Our results are consistent with the literature in that they show that children in these language groups have the ability to understand and ascribe mental states to others (Wellman, 2011). These findings suggest that older children demonstrated an understanding of Theory of Mind explanations, producing more accurate responses than younger children. This difference in accuracy indicates that children's ability to comprehend and communicate mental states and intentions may improve with age. Furthermore, our findings align with the literature by showing that children are also able to provide explanations for the behaviour and motivations of others (Hickling & Wellman, 2001). This shows that children have the ability to think critically and make sense of the world around them, even at a young age (Peterson & Riggs, 1999). Our study has shown that the Theory of Mind competency is present in the age of five years, and this is consistent with the study of Peterson and Riggs (1999) who observed that this competency develops around the age of four years. As Flavell and Miller (1998) argued that children gradually develop the ability to understand people's thoughts and feelings, our study has demonstrated that this indeed develops with age. Furthermore, our results show that the ability to produce Theory of Mind explanations is not language specific as all the three Bantu languages have shown the ability to produce this explanation type.

Causal Explanation

In this explanation type, we sought to encourage participants to think critically about the causes and effects of different events or behaviours happening in the visual stimulus. The question asked sought to encourage participants to think about the underlying reasons or causes for

Jerry's behaviour in the cartoon. It attempted to make participants engage in causal reasoning. It invited participants to consider the factors that might have influenced Jerry's actions such as motivations.

The pattern of clause production in the Causal explanation type reveals a notable variation between the three language groups, with the Sesotho and Tshivenda groups demonstrating a tendency towards longer and more detailed explanations, while the isiZulu group adopted a more concise approach. This finding suggests that children from the Sesotho and Tshivenda groups may be more inclined to provide a rich and thorough account of causal relationships in their explanatory discourse, while children from the isiZulu group may prioritise efficiency and concision in expressing causal information.

Our analysis of response accuracy in Causal explanation revealed a relatively balanced distribution of accurate and inaccurate responses across the three language groups. However, the isiZulu group showed a notable strength in producing accurate responses for this explanation type, outperforming the other two language groups. This finding suggests that, despite the relatively equal distribution of accurate and inaccurate responses overall, the isiZulu group demonstrated a heightened ability to accurately explain causal relationships in this explanation type. We note that participants in these language groups were able to give accurate responses because of some of the causal explanatory strategies such as using phrases such as "because" and "so" to achieve a logical reasoning. They were able to infer causal relationships between events or factors using such phrases to indicate causal connections. Furthermore, we noted that they were able to identify multiple causal factors contributing to an outcome or event, highlighting the relationship between different factors and their impact on the outcome. All the language groups showed an understanding of the prompt and each produced an accurate or inaccurate responses.

Our findings revealed that both the Sesotho and Tshivenda groups produced the same highest mean number of gestures in Causal explanations, with representational gestures being the most prevalent. By contrast, the isiZulu group did not produce any gestures. These patterns of gesture use indicate that the role of gesture in explanatory discourse can vary significantly across different language groups. Representational gestures, which depict actions or objects, are commonly used to supplement oral explanations, helping to clarify or emphasise key aspects of the explanation. This shows that most of the employed gestures brought new information that was not encoded in the explanation.

The Causal explanation type displayed a distinct pattern of clause production across age groups, with older children producing longer explanations with more clauses than younger children. Interestingly, this finding differed from the patterns observed in other explanation types. The variation in clause production across age groups highlights the developmental nature of explanatory discourse, with older children demonstrating a greater capacity for elaborate and complex explanations than their younger counterparts. Our analysis of response accuracy in Causal explanations revealed that older children were more likely to provide correct explanations than their younger counterparts, suggesting a developmental progression in the ability to accurately explain causal relationships. Furthermore, younger children produced a higher proportion of incorrect responses, indicating that this explanatory ability continues to develop with age. These findings highlight the crucial role of developmental factors in the ability to understand and communicate about causal relationships, with older children having a greater proficiency and accuracy in their Causal explanations. In our analysis, we note that older children may have achieved a higher number of accuracy because they were able to recognise the sequence of events that led to a particular outcome. For instance, they might have noticed that the baby bird was ruining Jerry's furniture as a cause that led to the outcome of him taking the baby bird back to the nest.

Our findings regarding the use of gestures in Causal explanations revealed that younger children produced more gestures than their older counterparts. Interestingly, there were no gestures produced in any of the languages in group 2, indicating a decrease in the use of gesture with age. The types of gestures observed in group 1 were mostly performative, which typically involve head and facial movements that effectively communicate speech acts or reinforce verbal messages without the use of spoken words

Our results align with previous research that has shown that children are capable of understanding and applying general principles of causality in diverse contexts, ranging from physics to human interactions (Wellman & Gelman, 1998; Kushnir & Gopnik, 2005). This competence is reflected in our findings, where participants were able to generate accurate explanations of causal relationships. Furthermore, our findings show that the ability to provide causal explanations increases with age. The results indicate that the ability to produce Causal explanations is not language specific as all the three languages have shown the ability to produce this explanation type.

A synthesis of the results across all explanation types reveals a different pattern of explanatory communication among the three language groups. The difference in clause counts and accuracy for Hypothesis Formulation, Procedural, Theory of Mind, and Causal explanations indicate that the strategies and skills employed by participants from each language group varied according to the type of explanation required. This suggests that each language group employs distinct explanatory approaches depending on the type of explanation required. When looking at the three languages, we note that both the Sesotho and isiZulu groups performed better in the Causal explanation. This is noted in the fact that there are more correct responses for this explanation type than in any other explanation type. Both language groups performed poorly on the Hypothesis Formulation explanation. This is noted in the fact that there are less correct responses for this explanation type than any other explanation. Interestingly, the Tshivenda group performed better in the Hypothesis Formulation explanation than in any other explanation type. This is seen in the fact that there are more correct responses for this explanation type than in any other explanation type. The language group performed poorly in both Procedural and Theory of Mind explanation types. This is observed in the fact that there are fewer correct responses in this explanation types.

A summary of the correct responses across the four explanation types indicates that the Causal explanation was associated with the most correct responses, followed by the Theory of Mind and then the Procedural explanation. The Hypothesis Formulation explanation generated the fewest correct responses, suggesting either a relative difficulty for participants in formulating accurate hypotheses or the prompt not being efficient in soliciting the target response. However, all participants were able to produce a response.

Conversely, the relative difficulty of Hypothesis Formulation explanations may reflect a greater cognitive demand, as participants are required to generate novel hypotheses based on visual stimulus, rather than simply describing or explaining existing knowledge or experience. This type of reasoning may rely on different cognitive processes or resources than the other types of explanations. Additionally, there might be a potential influence of educational experiences on explanatory performance. Certain explanation types, such as Causal and Procedural explanations (Rittle-Johnson & Alibali, 1999), may be more explicitly taught and practised in school settings, whereas others, such as Hypothesis Formulation, may receive less attention or instruction. In their study, Rittle-Johnson and Alibali (1999) demonstrated that students who study mathematics in schools possess procedural knowledge, and they are capable of following

procedures. Overall, these findings highlight the complexity of explanatory communication and the importance of considering multiple factors in understanding children's explanatory skills.

Considering the role of gesture in the oral explanations, the results demonstrated that all language groups produced gestures, however not in a similar way. Furthermore, there were not many gestures that were produced in this study. While gesture was present in the oral explanations of all three language groups, the distribution of these gestures was not the same. The Sesotho group produced the most gestures in all the explanation types. This was followed by the Tshivenda group, and lastly, the isiZulu group. In this study, explanations were accompanied by representational, performative, and discursive gestures. It should be noted that the characteristics of the explanatory task, the interviewer and the dialogic exchange, might have conditioned the gestural behaviour of the participants in this study. The Sesotho group produced more of these three gesture functions than the other two language groups. Across the two age groups, we note that group 2 participants produced more representational and discursive gestures while group 1 participants produced more performative gestures. These results are consistent with the co-speech gesture literature (Alamillo et al., 2013; Colletta et al., 2010; Colletta & Pellenq, 2009; amongst others). As children mature and refine their discourse production abilities, they tend to use complex gestures, increasing the frequency of representational and discursive gestures. This study shows younger children tend to use more performative gestures, which are less complex in their explanation, while older children use more representational and discursive gestures. These findings contribute to the growing body of knowledge on gesture development, especially in non-narrative discourse.

Most of these gestures aimed to supplement and integrate the produced explanations across the language groups. Across the two age groups, group 1 most often supplemented their explanations with gestures while group 1 integrated and reinforced their explanations with gestures. This difference in gestural strategies suggests a developmental progression in children’s ability to use gestures as a cohesive part of their explanatory repertoire.

Across all the languages, we note that there might be an influence of language and culture on gestural production. Kunene Nicolas (2015) has shown that Bantu language speakers tend to give more visual performance in their communicative task. This means that the more information they give in their speech, the more they want to give their visual performance. Therefore, the higher number of gestures in the Sesotho group might be because of the language

and culture. Furthermore, these findings might suggest that the relationship between age and gesture is complex and may be shaped by specific cognitive demands of different types of explanations. Hypothesis Formulation and Causal explanation, for example, may require more abstract reasoning for which younger children may compensate through greater use of gesture. Conversely, Procedural and Theory of Mind explanations may involve more concrete reasoning, where older children may use gesture more frequently to emphasise key points. These findings suggest that the role of gesture in explanation varies depending on the explanation type and linguistic and developmental stage of the participant.

5.1 Limitations

While the results from this study are informative, the researcher acknowledges several limitations that should be born in mind when considering the implications of the findings. Firstly, cultural differences might have influenced the findings in the sense that the experiment was targeting French, American English and Italian. For the Bantu languages, an additional task of adapting the conceptual basis of the different explanation types needs to be developed. The study only focuses on children and has no adult control group. The findings would have been further strengthened by investigating adult explanatory abilities to create a baseline in which to understand how the children were performing. However, despite these limitations, the current study provides valuable insights into the relationship between languages, gesture, and explanatory discourse in three Bantu languages, and serves as a useful starting point for future research on this important topic.

5.2 Future directions

Based on the findings and limitations of this study, several recommendations can be made for future research on explanatory discourse in isiZulu, Sesotho, and Tshivenda, and potentially other Bantu languages. Future research should expand sample size in order to improve the generalisability of the findings. Researchers should consider controlling for potential cultural factors that might influence explanatory discourse, such as differences in communication styles or educational background. Investigating the linguistic features of these languages, such as morphological complexity could shed light on how these factors might influence explanatory discourse. Lastly, scholars should consider comparing with other language groups as this could provide an understanding of the relationship between language, gesture, and explanatory discourse across different linguistic and cultural backgrounds.

5.3 Conclusion

In conclusion, the present study focused on the effects of language and age on explanatory abilities. It aimed to examine how explanations are produced by speakers of isiZulu, Sesotho, and Tshivenda (South African Bantu languages) who are between the ages of 5– 6 years and 9–10 years. It is an intra-comparative study that investigates if explanatory abilities in children are language specific or universal. We observed different pattern of explanatory communication among the three language groups, suggesting that each language group employs distinct explanatory approaches depending on the type of explanation required. Furthermore, we observed that the role of gesture in explanation varies depending on the explanation type and linguistic and developmental stage of the participant. The findings of this study underline the importance of considering the unique linguistic and cultural factors that influence children's development of communicative skills, and the need for ongoing research to deepen our understanding of this human development.

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Appendices

Appendix A: Ethics Waiver

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE

(NON-MEDICAL)

Registration number: REC-101114-044

19 March 2024

Re: Mr Thupetsi Lucky Mahlatji (1894929)

Waiver letter number: HRECNMW24/04/03

To whom it may concern,

Mr. Mahlatji is a student in the School of Literature, Language and Media at the University of the Witwatersrand, Johannesburg. This letter is to confirm that, at the time of writing, Mr. Mahlatji does not need ethical clearance for his study entitled *'A comparative study on the explanatory development in SA Bantu languages'.* This decision has been reached based upon a description of the project supplied by Mr. Mahlatji to the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the Chairs and Deputy Chairs. If, however, Mr. Mahlatji changes the methods of data collection and analysis for this study, this decision may no longer be valid. If such changes take place, this should be communicated to the University Human Research Ethics Committee (Non-Medical) as soon as possible. This waiver letter is valid until 18 March 2027.

Please feel free to contact me should you require any further information.

Thank you.

Yours sincerely,

Shaun Schoeman (Administrative Officer)

Solomon Mahlangu House, 10th Floor, Room 10004, Jorissen Street, Braamfontein, Johannesburg Private Bag 3, Wits 2050 + 27(0)11 717 1408 | **E** Shaun.Schoeman@wits.ac.za | hrec-medical.researchoffice@wits.ac.za

www.wits.ac.za/research/about-our-research/ethics-and-research-integrity/

Appendix B: 5-6 years old – Explanations

IsiZulu

ZEXPL5YF09

Hypothesis Formulation Explanation

"Akukhumbule kancane, uyakhumbula lenkathi ehh… leyanyoni le ises'dlekeni kunale qanda lapha noma ibola noma kuyini, uyakhumbula. Mawucabanga wena lenyoni indize yashonaphi?"

"*Indize yabaleka"*

"It flew away."

Procedural Explanation

"Okay… leqanda noma le bola lela lifike njani kuleyandlu leya? Lihambe njani?

Ibiy'hambela, lihamba libumpa."

"It was jumping around."

Theory of Mind Explanation

"Okay*… uma lesikhathi leqanda leli seligcina sekuyi yitshwele, ubonile, ubonile kuthi lijabulele ukubona loyamunt'omdala loya, yini okwenze kuthi lijabule ukubona loyamunt'omdala? Awusakhumbuli?"*

"Beli…."

"It was…"

Causal Explanation

"Okay*… yini okwenza kuthi lomunt'omdala athathe leletshwele lela aphinde alibuyisele esidlekeni?"*

"Angazi."

"I don't know."

Sesotho

SEXPL5YM05

Hypothesis Formulation Explanation

"Alright*… o nahana ho re why mme o la wa nonyana a ile a tsamaya a si ya nonyana?"*

"Alright... so, in you opinion, why did the mother bird fly and leave its baby bird behind?"

"*Because o batla ho ya ko mmm ko ko ditshoming tsa haye… o batla ho ya ko ditshoming tsa haye… haqeta mae a tswa… haqeta nonywane e la ya tswa…. Haqeta Tom and Jerry a e busetsa… a e apesa kobo.*"

"Because it wants to go to its friend… it wants to go to its friends… after the egg hatched… after that, that bird came out… after that, Tom and Jerry took it back… he covered it with a blanket."

Procedural Explanation

"Manje leqanda le le fihlile jwang ko ntlung ya Tom and Jerry?"

"So, how did the egg get into Jerry's house?"

"Le fihlile hantle… Le jampile la jampa maqeta la ya ko nthong ya sefata and then maqeta ya yah abo […] maqeta… maqeta ya ya ko difolaweng maqeta folawa (flower) ya yehlisa maqeta ya ya ko Tom and Jerry… maqeta Tom and Jerry a dul… a robala ko yona and then Tom and Jerry a se […] go na le mae ko yena … and then Tom and Jerry … Tom and Jerry a busetsa ko ko sehlareng and then Tom and Jerry a e robadisa maqeta Tom and Jerry a e apesa kobo and then a robala."

"It got there well… It jumped and after it went to the house tree and then after […]… after it went to the flowers… and then the flower made it roll to Tom and Jerry's house… and then after, Tom and Jerry went to sleep next to it… and then Tom and Jerry […]… there were eggs and then Tom and Jerry… Tom and Jerry took it back to the tree and then Tom and Jerry took it to sleep and then after Tom and Jerry covered it with a blanket."

Theory of Mind Explanation

"Okay.. and then *o nahana ho re why nonyana e la ha e bona Tom and Jerry e ile ya thaba?"*

"Okay... so, why was the baby bird happy when it saw Jerry?"

"And then *nonywana ya mama ke Tom and Jerry ya bona mama hae … ya haka Tom and Jerry maqeta … maqeta Tom and Jerry a dula ko yona… mae a dula ko yona… and then non… a se bona ka ka mae ko hae… and then… and then Tom and Jerry a e busetsa. O tlo fihla mama nonywane… and then… and then Tom and Jerry a e busetsa … A e robadisa… and maqeta ya robala and Tom and Jerry a e apesa kobo… and maqeta ehhh and Tom and Jerry a tsamaya a ya ko ntlung ya hae a ya ho robala"*

"and then, the bird's mother is Tom and Jerry. It saw its mother. It hugged Tom and Jerry after… after Tom and Jerry sat on it… the eggs sat on it… and then he saw the egg at home… and then… and then Tom and Jerry took it back. The mother bird will come back… and then Tom and Jerry took it back. He took it to sleep… and then after, it slept and Tom and Jerry covered it with a blanket… and after Tom and Jerry went to his home to sleep."

Causal Explanation

"Okay… *manje o nahana ho re why Tom and Jerry a e nkile a yi sa ko setlhareng… a e ntshitse ko ntlung ya hae a yi sa ko setlhareng?"*

"*Okay*... so, why did Jerry take the baby bird back to the tree? Why did Jerry take it out from its house and returned it to the tree?"

"Because *ya mo tena.*"

"Because it is annoying him."

Tshivenda

VEXPL5YM05

Hypothesis Formulation Explanation

"*Ho…. hovha hu na tshinoni.*"

"There… there was a bird."

Procedural Explanation

"Ehhh… zwino lo swikisa hani lia kumba nnduni ya Jerry?"

"*Ehhh*… So, how did the egg arrive at Jerry's house?"

"*Ho vho thoma a… a… ha bva… bva… mudi wa tshitaha ha mbo di da kumba, tshinoni tsha tsha… bvelela tshi tshi… tshe tshitukutuku tsha… tsha… tsha hula tsha vha tshihulwane tsha kona… tsha kona u fhufha, ha bvelela mia tshinoni vha vha dzhia nga hetshila tshinoni, tshinoni tsha la vhurotho tsha dovha tsha fhiwa vhunwe vhurotho tsha la na tshidulo vha tshi isa tshitumbani."*

"Firstly, the nest went out then the egg followed, the bird popped out very small it then grew and was able to fly, the bird's mom came out and she took that bird, the bird ate bread and it was given another bread and the bird ate and the chair and they took the bird back to the nest."

Theory of Mind Explanation

"Ehh… zwino ndi nga mini ula nwana wa tshinoni o mbo di tout akala a tshi vhona vho mbevha?

"Ehh… So, why was the baby happy to see mouse?"

"Ho vha ho bvelela, thi ho vha ho bvelela kumba ha mbo di da tshinoni, tshinoni tsha fhiwa vhurotho, tshinoni tsha dovha tsha fhiwa na tshidulo, tshidulo tsha vheiwa nga vhurotho tshononi tsha la, tshinoni tsha takuliwa… mia hone vha takula hetshila tshinoni vha tshimbila vha tshimbila vha tshimbila vha isa tshinoni tshitumbani."

“The egg came out followed by the bird, the bird was given bread, it was also given the chair, the chair was placed by the bread and the bird ate, the bird was carried, the mother carried the bird then she walked and walked to the nest.”

Causal Explanation

"Ndi… ndi nga mini vho mbevha vho dzhia ula nwana vha muhumisela tshitahani?”

“Why… why did the mouse take that baby bird back to the nest?”

"Ho vha hu na kumba helia tshinoni tshi saathu hula tshi tshi tovha tshihulwane ngori hovha hu tshe na kumba, tshinoni tsha la vhurotho na tshidulo tsha mbo di tuwa tsha isiwa tshitahani.”

“There was an egg before the bird grew up when the bird became big the bird ate the bread and chair and it went to the nest.”

Appendix C: 9-10 years old – Explanations

IsiZulu

ZEXPL9YF03

Hypothesis Formulation Explanation

"Yindaba lela dada ek’qaleni lishiye isidleke neqanda?”

“Why did that bird leave the nest in the beginning?”

"Be be dlile.”

“They had eaten.”

Procedural Explanation

"Lifika njani iqanda endlini?”

“How did the egg arrive at the house?”

"Lifike lawa es’dlekeni… esidlekeni bese ke lase lawa. La round isidleke bese lawa… Isidleke bese lawa esdlekeni. Lase la ngena entambeni yes’spider lase lawa la bamba entabeni yes’spider bese lawa futhi […] kwakukhona uhlamvu […] lase lahamba… laze lafika endlini.”

“It first fell on the nest, and then fell. It rounded the nest… the nest fell on the nest. And then it fell on the spider-web and then fell on the spider-web, and then fell again. There was […] and then it went to the house”

Theory of Mind Explanation

"yindaba lela dada elincane lijabula ukubona ikati?”

“Why was the baby bird happy to see the cat?”

"Melicabanaga kuthi umawayo."

"It thought it was its mother."

Causal Explanation

"yindaba le… le… lela kati libuyisela idada esidlekeni?"

"Why did that… that… that cat take the baby bird back to the nest?"

Meliyihlupha.

"It was bothering it."

Sesotho

SX10F08

Hypothesis Formulation Explanation

"O nahana ho re hobaneng lejuba ne le tsamaya le si ya lee?"

"why did the mother bird leave its egg behind?"

"Ho ba se le tswile."

"Because it went out."

Procedural Explanation

"Lee le fihlile jwang ko ntlung ya Jerry?"

"How did the egg get into Jerry's house?"

"Le ile... a ke re le ile la jampa a fetsa la ya ko spider-web a fetsa ya ya ko folaweng a fetsa ya ya ko... ko nthweng ya grass a fetsa ya ke na ntho... ko ntlung ya Jerry"

"The egg… it jumped and then it went to the spider web and then it went to the flower after that, it went to the grass thing and then it went to Jerry's house."

Theory of Mind Explanation

"Nonyana e nyane ne e thabetseng ha e bona Jerry?

"Why was the baby bird happy when it saw Jerry?"

"*Ne e thabetse o ka... ho re ke mme wa yona"*

"It was happy because it thought it was its mother."

Causal Explanation

"Jerry hobaneng a ile a nka nonyane a e kgutlisetsa kwa hodimo ko sefateng?"

"Why did Jerry take the baby bird back to the tree?"

"*Ho ba a se... a se mme wa yona"*

"Because it is not its mother."

Tshivenda

VEXPL9YF10

Hypothesis Formulation Explanation

"Mathomoni thomoni kha nganeapfufhi heilani, ro sumbedziwa mathomoni mia tshinoni a tshi bva tshitahani, ndi nga mini?"

In the beginning we were shown that the mother went out, why did she?"

"Vha vha tshi khoyo toda zwiliwa."

"She went to look for food."

Procedural Explanation

"Lo swikisa hani kumba liya fhala mudini wa Jerry?

"How did the egg arrive at Jerry's house?"

"o vha li kho tshimbila li kho soko mona hafhala ntha ha tshitaha, la mbo di wa la wela maluvhani la kunguluwa la kunguluwa la swika la gogonya vothi la vulea la dzhena la ya la edela na Tom"

"the egg was roaming around on top of the nest, then it fell on top of the flowers, It rolled and rolled and then it banged the door, the door opened the egg went in and went to sleep with Tom."

Theory of Mind Explanation

"O vha o to dala madakalo nwana wa tshinoni musi a tshi vhona Jerry, ndi nga mini? ndi nga mini mwana o la wa tshinoni a tshi tou bona Jerry a dala madakalo?"

"The baby bird was so happy when it saw Jerry, why was it? Why was it happy to see Jerry?"

"Ngori o wana o edela"-

"She found it sleeping"

Causal Explanation

"Ndi nga mini Jerry a tshi dzhia ula nwana wa tshinoni a tshi humisela ngei tshitahani tshatsho?"

"Why did Jerry take the baby bird back to its nest?"

"O vha a tshi kho silinga"

"because it was troublesome."

Appendix D: Editing Certificate

Anne Peltason Academic Editor
Editing Certificate

University of the Witwatersrand:

Supervisor: **Prof. Ramona Kunene Nicolas**

This serves as proof of Language Editing of a dissertation submitted in partial fulfilment of the requirements for a **MASTERS IN LINGUISTICS** at the University of the Witwatersrand

On Behalf of**: THUPETSI LUCKY MAHLATJI**

I, Anne Marjorie Peltason, hereby certify that I have completed the Language and Technical Editing of the pages of a thesis towards a Masters Degree in linguistics on the topic **A comparative study on the development of explanatory abilities in South African Bantu languages.**

I believe that the thesis meets with the grammatical and linguistic requirements for a document of this nature. The aspects as listed were covered in the process of the editing.

A full language edit was completed: grammar, spelling, and expression.

A. M. Peltason

30 March 2025

The editor takes no responsibility for plagiarism or any alterations to the documents after final submission to the author.

The following were included:

- Reference formatting according to the style used by the author;
- In-text citations against the reference list;
- Standardising of heading styles and captions of tables and figures in the style selected by the author;
- Accuracy of Figures and Tables, including whether reflected by the Table of Contents;
- Formatting of Table of Contents and pagination.

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