

EMERGENCE OF NEGATION IN A TURKISH HOMESIGN SYSTEM:
INSIGHTS FROM THE FAMILY CONTEXT



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2024

EMERGENCE OF NEGATION IN A TURKISH HOMESIGN SYSTEM:
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Thesis submitted to the
Institute for Graduate Studies in Social Sciences
in partial fulfillment of the requirements for the degree of

Masters of Arts
in
Cognitive Science

by
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Boğaziçi University

2024

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Insights from the Family Context

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- this is a true copy of the thesis approved by my advisor and thesis committee at Boğaziçi University, including final revisions required by them.

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ABSTRACT

Emergence of Negation in a Turkish Homesign System: Insights from the Family Context

The homesign systems, which are gestural communication invented by deaf individuals without access to any conventional language input (Goldin-Meadow, 2003), provide a unique context to comprehend what characteristics are fundamental in human language. The fact that these systems presented various characteristics of conventional languages in lack of a model raised questions about whether interlocutors of homesigners present any structure with their gestures. In the current study, I focused on a homesign system used by a Turkish homesigner child, Deniz, and his mother and sister. Specifically, I investigated the negation gesture patterns of the family to understand whether a consistent structure exists and how it affects the individuals in the family at different levels. The findings revealed that both the sister and the mother presented consistent negation structures but differed from each other. Deniz could follow these patterns and adapted the negation gestures based on his interlocutor. However, he presented a limited ability to concatenate gesture units linearly compared to his mother and sister. These similarities and differences between family members and the role of input are discussed in line with the research questions and previous studies.

ÖZET

Türk Ev İşaret Sisteminde Olumsuzlama Oluşumu:

Aile Bağlamından İçgörüler

Herhangi bir geleneksel dil girdisine erişimi olmayan sağır bireyler tarafından icat edilen jestsel iletişim türü olan ev işaret sistemleri (Goldin-Meadow, 2003), insan dilinde hangi özelliklerin temel olduğunu anlamak için benzersiz bir bağlam sunmaktadır. Bu sistemlerin, bir modelin yokluğunda geleneksel dillerin sahip olduğu çeşitli özellikleri sunması, ev işaretçilerinin iletişim kurduğu kişilerin jestleriyle herhangi bir tutarlı girdi sunup sunmadığına dair soruları gündeme getirmiştir. Bu çalışmada, Türk ev işaretçisi bir çocuk olan Deniz ile annesi ve kız kardeşi tarafından kullanılan bir ev işaret sistemine odaklandım. Özellikle, tutarlı bir yapının var olup olmadığını ve birbirlerini hangi düzeyde etkilediğini anlamak için ailenin olumsuzlama jesti örüntülerini araştırdım. Bulgular hem kız kardeşin hem de annenin tutarlı olumsuzlama yapıları sunduğunu ancak bu yapıların birbirinden farklılaştığını ortaya koydu. Deniz bu kalıpları takip edebiliyor ve olumsuzlama jestlerini iletişim kurduğu kişiye göre adapte edebiliyordu. Ancak, annesi ve kız kardeşine kıyasla jest birimlerini doğrusal olarak birleştirme konusunda sınırlı bir beceri sergiledi. Aile üyeleri arasındaki bu benzerlikler ve farklılıklar ile girdinin rolü, araştırma soruları ve önceki çalışmalar doğrultusunda tartışılmıştır.

ACKNOWLEDGMENTS

Firstly, I would like to thank my supervisors Prof. Aslı Özyürek, Assist. Prof. Kadir Gökgöz and Assist. Prof. Beyza Sümer who encouraged me to follow my research interests and gave valuable feedback throughout the research. I was very impressed by a paragraph I read in a book five years ago, and now I have written this thesis with the authors of that paragraph. This was the most valuable part for me. I am also grateful to my committee members Assoc. Prof. Didar Akar and Assist. Prof. Nazik Dinçtopal and my collaborator Elvan Tamyürek Özparlak for their valuable time and contributions to this thesis.

I am thankful to my beloved friends Selin Berjin İke, and Mahmut Kurupunar who have been a part of my academic and personal journey in the last years. I would also like to express my gratitude to my late friend Özge Özer and my valuable colleague Mehmet Ak for their support, which made my thesis process and my life much easier.

Lastly, I am grateful for the love and belief of my family, Mihriye Kan, Eda Kan, and to İlkay Güngör and his family who welcomed me in the Netherlands at the beginning of my research process.

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CHAPTER 1

INTRODUCTION

The cruciality of input has been the subject of debate on language emergence and evolution. Across all linguistic properties, the input constitutes a reliable path for people to follow and interact with others. The necessity of instructive data for developing language properties has been extensively studied over the decades. The different levels of linguistic inputs, i.e., naturally occurring or experimentally manipulated, have been the subject of language investigations to grasp how the language developed and the potential consequences of input scarcity. The complete absence of conventional language input has also been explored through unique case studies such as homesign systems, which are regarded as spontaneous gestural systems created by deaf individuals who have no access to any sign or spoken language (Goldin-Meadow, 2003). The homesign studies have comprehensively focused on deaf children and their immediate environment to understand whether and how linguistic properties emerge in the lack of conventional language input. Even though there is a lack of linguistic input, these systems demonstrated various language properties such as basic syntax and stable lexicon (Goldin-Meadow & Yang, 2017; Richie, Yang, & Coppola, 2014), subject, noun, and verb categories (Coppola & Newport, 2005; Hunsicker & Goldin-Meadow, 2013), complex sentences and noun phrases (Flaherty, Hunsicker, & Goldin-Meadow, 2021; Goldin-Meadow & Mylander, 1983; Wang, Mylander, & Goldin-Meadow, 1993), negation & questions (Franklin, Giannakidou, & Goldin-Meadow, 2011; Kan, Gökgöz, Sümer, Tamyürek, & Özyürek, 2022). However, some of the previous studies have not investigated the interlocutors of homesigners. Specifically, in the study of Franklin et

al. (2011), negation gestures used by family members around David were not analyzed to assess whether they constituted a negation model for him. This gap left the effect of input on the development of negation in homesign systems unexplored. In the present study, I examined the homesign system used by a Turkish deaf boy and his family to document and compare their negation patterns.

In the first chapter of this study, I provide a literature review to outline the content and purpose of my research. Additionally, I aim to attract attention to the literature gap and this study's importance. Specifically, I begin with a summary of how hearing and deaf children acquire language through language input and the implications of its lack. In the subsequent sections, I provide a comprehensive review of the homesign literature by focusing on homesign systems across different homes, their system characteristics, and their users. The final section of this chapter highlights the development of negation in hearing and deaf children, the importance of this research, and my research questions.

In the second chapter, I detail the participants and the context of the study, the data collection process, and my coding scheme to portray the communication dynamics among family members. Following the methodology, I provide the results concerning all parameters in the third chapter. After presenting the key findings, I discuss the negation patterns of family members in line with the research questions and previous studies.

1.1 The puzzle of linguistic input

A large body of studies from diverse perspectives, as outlined below, were conducted to understand the effect of input on the process of language acquisition and language learning. Generally, these studies focused on various aspects such as the amount of

input, language delay, or people with cognitive disabilities. To remove linguistic input intentionally would be one approach to examining whether the properties of language emerge through exposure or innate mechanisms. However, this unethical manipulation would cause language deprivation. Therefore, investigating atypical contexts, such as a child having little-to-no access to language, can contribute to solving the puzzle of input. It is necessary to work on naturally occurring cases involving children without any physical, social, or cognitive disabilities and who are not exposed to structured input from birth.

Most hearing children have audial and visual access to the language from birth. They are exposed to spoken language used in their environment and engage in communication with their speech community (Gleitman & Newport, 1995). However, atypical conditions such as socioeconomic disadvantages or genetic/neurological disorders (i.e., Autism Spectrum Disorder, Down Syndrome) may adversely affect some children's language development and cause language deprivation (Ratner, 1997). Although their language deprivation prevents them from fully benefitting from linguistic input, these children take a variety of linguistic inputs from birth. Thus, they cannot be regarded as experiencing a full lack of model. Moreover, in cases such as Genie and Victor, even though they had not been exposed to linguistic input since birth, they exhibited severe social and cognitive disabilities (Curtiss, Fromkin, Krashen, Rigler, Rigler, 1974; Lane, 1976). These disabilities made them incomparable with those who typically developed and were exposed to conventional input from birth. As a result, the conditions of these individuals do not meet the criteria to study the absence of linguistic input.

On the other hand, the World Health Organization (2021) reported that more than 430 million people experience mild-to-severe levels of hearing loss. As the

degree of hearing loss increases, it becomes more difficult for deaf people to learn a spoken language (Humphries et al., 2014). Thus, most of these individuals who are congenitally deaf communicate using sign language. Therefore, the size of the deaf population using sign languages and the diversity of these languages require special attention. Since the pioneering study of Stokoe (1960), sign languages have become part of the linguistic field. They have all aspects of linguistic structures, just as spoken languages do (Liddell, 1980). Following this fully-fledged structure, deaf children born to deaf parents acquire sign language as their hearing counterparts acquire spoken language (Lillo-Martin, 1999; Newport & Meier, 1985; Petitto & Marentette, 1991). They practice language learning skills with the help of consistent linguistic input. They follow the language development milestones similarly to their hearing peers (Bonvillian, Orlansky, & Novack, 1983; Newport & Meier, 1985).

However, most of the deaf children around the world have limited or no access to sign language input. Hearing parents of more than 90% of deaf children cannot or choose not to provide sign language to their children (Hall, 2017; Mitchell & Karchmer, 2005). These hearing parents mostly experience difficulties developing effective communication with their deaf children (Vaccari & Marschark, 1997; Whicker, Muñoz, & Nelson, 2019; WHO, 2021). While some parents choose to educate their deaf children using oralist methods by attempting to teach them lipreading and speaking, some others choose to enroll their deaf children in deaf schools or schools with sign language education. The performance of these children who acquire sign language later in life is usually lower than those who acquire sign language as a native (Mayberry, 1993; Mayberry & Kluender, 2018; Newport, 1990). Consequently, the language acquisition process of deaf people has provided a valuable window into discovering the role of input.

1.2 The scaffold of language emergence: The homesign systems

The majority of deaf children have limited access to sign language input (Mayberry, 1992). The profound hearing loss prevents these children from acquiring spoken language used in their immediate environment. Also, if their hearing parents do not put them in sign language education, they will not have any sign language model. In such scenarios, deaf children use their hands to interact with people around them (Goldin-Meadow & Mylander, 1998). Despite the lack of linguistic input, deaf children, who have no social or cognitive impairments and are considered to develop typically, create gestural communication systems named 'homesign' (Golding-Meadow, 2003). These systems are characterized by being created by individual deaf people and hearing interlocutors. For this reason, the initial stage of emergent sign languages is regarded as individual homesign systems, i.e., the root of the language emergence process is tracked back to deaf individuals without linguistic input (Senghas, Ozyurek, & Goldin-Meadow, 2013). Once the homesign is shared within the community, it is raised and transmitted across generations. Following this sharing and transference, it evolves into an emergent sign language (Sandler, Meir, Padden, & Aronoff, 2005; Senghas, Kita, & Ozyurek, 2004).

To locate homesign systems into sign language typology, Reed (2022) offers a classification of the sign languages based on sociodemographic features: deaf community sign languages, village sign languages (named rural sign languages, de Vos & Pfau, 2015), family sign languages (named family homesign, Haviland, 2013), and homesign languages. She listed the features of the homesign as the following (Reed, 2022, p. 5):

1. The product of a single deaf person not in contact with other deaf people
2. Associated with children in nuclear families

3. Chiefly the product of the deaf individual
4. Characterized by frequently unsuccessful attempts at communication by the deaf signer
5. Not transmitted intergenerationally

With these features, homesign was perceived as an idiosyncratic invention by individual homesigners, restricted to interactions with only hearing people, particularly the nuclear family. The creation of this system was mainly attributed to the homesigner (Goico & Horton, 2023), and the role of hearing interlocutors was not emphasized. Additionally, ineffective interaction efforts were highlighted. Finally, the homesign remained only in the family it arose from and was not transmitted to other deaf people or the next generations.

The research that defines those features of the homesign systems has mostly been conducted with deaf children in Western countries and urban areas. Specifically, Feldman, Goldin-Meadow, and Gleitman (1978) introduced the ‘homesign’ concept in their United States study. Following this, homesign has extensively been investigated in different parts of the world such as China, (Wang et al., 1993; Yau, 1992), Nicaragua (Coppola, 2002), Japan (Torigoe & Takei, 2002), Turkey (Golding-Meadow, Ozyurek, Sancar, & Mylander, 2009; Kan et al., 2022), Brazil (Fuselier-Souza, 2006), Mali (Nyst, Sylla & Magassouba, 2012), Mexico (Haviland, 2013; Hou, 2016), Thai (Nonaka, 2014), Nepal (Green, 2014, 2017), Guatemala (Horton, 2018), Cambodia (Moriarty Harrelson, 2019), Peru (Neveu, 2019) and Papua New Guinea (Reed, 2020). Homesign systems have exhibited significant diversity in terms of community structure, deaf-hearing interaction, and variability of input, as the findings started to come from the Global South and rural areas (Goico & Horton, 2023). After these diverse results, the reclassification of homesign systems became

more crucial. For example, Nyst et al. (2012) distinguished between homesign systems by classifying them into two categories, rural homesign and oralist homesign, to cover diverse types of homesign. Zeshan (2010) also defined two categories of homesign: 'homesign' and 'communal homesign'. Horton (2020) offered alternative categories as individual homesign systems and shared homesign systems. Following this, Reed (2022) classified homesign into two categories: oralist homesign and rural homesign. In addition to the list above, she defined features for oralist homesign as the following (p. 6):

1. Associated with urban areas
2. The caregivers of the deaf child are attempting to teach them to lipread and speak; they may avoid gesturing with the deaf child.

The oralist homesign was associated with urban areas, mostly in Western countries. Goldin Meadow (2003) noted that hearing families of homesigners strived to teach their children lipreading and speaking while avoiding gesture usage in their communication. This decision resulted in an unproductive context for deaf children to develop their language skills. On the contrary, Reed (2022) defined rural homesign features with the following (p. 6):

1. Associated with both children and adults in rural areas
2. The deaf user may or may not be in contact with other deaf people
3. Often the product of both a deaf person and hearing community members
4. Variability in how fluent communication is
5. May be transmitted intergenerationally
6. There is often a community expectation that the way to communicate with deaf people is to use gestures.

The rural homesign is associated with rural areas. It involves people of different ages and is not restricted to children. The first important distinction between oralist and rural homesign is that the homesigner may have contact with other deaf people in rural areas. About this, Reed (2022) suggests nucleated sign language networks that picture different deaf individuals who live in the same region and have weak or strong ties. In rural areas, homesigners may keep up with other deaf people. Several deaf people may live in the same family and share the system. Contrarily, the homesigner may live in isolation as the only deaf person in the hearing community. In addition to this, it is emphasized that the homesign is created by deaf homesigner(s) and their hearing interlocutors. In rural areas, hearing individuals are more eager to use their gestures while communicating with deaf people (Kisch, 2008; Kusters, 2010). In her study, Reed (2022) had homesigner participants in marriage, having several children, having a job, and being a church member. These close relationships with hearing signers affected the structure of homesign systems in the emergence process. As a result, the homesign system may be shared within the same community, including the family, neighbors, and other members of the village.

In summary, the homesign systems share similarities and crosslinguistic differences (described in detail in Section 1.4). Although the classification has been made with a set of distinguishing characteristics, much more diversity exists (Nyst, 2010). The attitude toward deaf people, the number of deaf and hearing people, and communication dynamics constitute the identity of the homesign system.

1.3 The unique window to language development

All around the world, children learn their first language naturally through exposure, regardless of the active effort of their interlocutors to teach. In a short time, they gain

proficiency in the language they are exposed to. This universal path brings a controversial topic into the language acquisition and language learning literature: the role of input. Researchers discussed whether and how the input affects the way children acquire language. Specifically, they questioned whether some properties of language emerge even in the absence of linguistic input. The different perspectives have contributed to the ongoing debate on this topic. The nativist perspective argues that children are born with innate mechanisms which help them to acquire language. Those with a nativist perspective assert that children rapidly generalize the impoverished linguistic input and develop language properties (Chomsky, 1959; Gleitman & Newport, 1995; Goldin-Meadow, 2003; Gordon, 1985). According to this perspective, the language acquisition process is mainly driven by universal language mechanisms independent of the specific language children are exposed to or the amount of input they receive (Chomsky, 1965). Conversely, the functionalist or usage-based perspectives highlight the importance of communication and experience during language acquisition. Those with these perspectives emphasize that children analyze the linguistic data presented to them and extract patterns over time. However, they are not born with innate mechanisms, instead, they learn language through exposure. (Bates & Goodman, 1999; Bates & MacWhinney, 1982; Bates et al., 1998; Behrens, 2009; Goldberg, 2016; Lieven, 2016). Thus, children construct linguistic properties and generalize them based on their experiences disregarding inborn knowledge (Tomasello, 2005, 2009).

Therefore, homesigners have captured the interest of language researchers due to the unique context of their language acquisition and socialization (Goico & Horton, 2023). The homesign systems lack many of the conditions of conventional languages. First, there is the absence of linguistic input or language model. In other

words, in the beginning, there is no grammar or shared vocabulary for deaf children and hearing communication partners to follow. They only have spontaneous co-speech or silent gestures that probably lack structure. Second, hearing individuals use spoken language as a primary communication system. This restricts sharing of the homesign system because deaf individuals only rely on these gestural systems to communicate with those around them. On the other hand, hearing individuals generally do not primarily utilize this gestural system to communicate with each other. Therefore, hearing individuals do not experience the same pressure to engage with homesign as deaf individuals do. Third, this system is not shared within the community deaf children are living in. The population of the homesign system is very small. It is typically used by the deaf individual(s) and their immediate environment. Lastly, the system is not transmitted from one generation to the next generation and the users of the system have no explicit intention to establish such transmission (Goldin-Meadow, 2011). Consequently, interlocutors do not communicate under the pressure of transmissibility, which influences and shapes the evolution of language (Brighton, Smith, & Kirby, 2005; Kirby, Cornish, & Smith, 2008).

In recent decades, the investigation of homesign systems has provided a valuable window to the role of input in the emergence and development of natural language properties due to the conditions these systems have (in detail Section 1.4). Researchers have focused on whether natural language properties emerge in the communication of deaf individuals where linguistic input is absent and what properties are fundamental to language. Then, suppose a language-like property in a homesign system is similar to that found in conventional languages. In that case, researchers aim to identify which interlocutor is responsible for introducing such

structure into the homesign system. The child and adult homesigners, their hearing interlocutors, and deaf signers have been the main subjects of the homesign studies. Researchers have investigated whether hearing interlocutors, the primary communication partners of deaf children, provide consistent input in their interactions. Furthermore, the question extends to whether co-speech gestures of hearing interlocutors already possess inherent structure or become more structured during communication with deaf individuals. The important questions concern whether deaf children benefit from the input provided by co-speech gestures; and if so, whether deaf children learn or acquire the structure through this input and share the system with hearing individuals. Moreover, researchers aim to understand how children utilize any structured input they receive. Specifically, they consider several scenarios: deaf children may not benefit from this input or the input may not be sufficient to create any structure. If only one deaf child exists in a family, and the child gets inconsistent input from the gestures of the rest of the family, the child may adopt these co-speech gestures and use them as a scaffold to build the structure. Although others may share the system, the child introduces structure into it. Additionally, children may exhibit properties of natural language, and their interlocutors may not. In conclusion, the system may not be shared, and the child may be the one who creates it. It is crucial to examine the level of involvement individuals play in shaping and developing these gestural systems.

1.4 The language-like properties

The homesign systems have facilitated communication and expression for these deaf children with ‘language-like’ properties. Specifically, these systems exhibit basic syntax and stable lexicon (Goldin-Meadow, 2003; Goldin-Meadow & Yang, 2017;

Richie et al., 2014), subject, noun, and verb categories (Coppola & Newport, 2005; Hunsicker & Goldin-Meadow, 2013), complex sentences and noun phrases (Flaherty et al., 2021; Goldin-Meadow & Mylander, 1983, 1998; Wang et al., 1993), word order and event segmentation (Goldin-Meadow et al., 2009, 2015; Özyürek, Furman, & Goldin-Meadow, 2014; Zheng & Goldin-Meadow, 2002), negation & questions (Franklin et al., 2011; Kan et al., 2022), number (Coppola, Spaepen, & Goldin-Meadow, 2013; Spaepen, Coppola, Spelke, Carey, Goldin-Meadow, 2011), comprehensibility (Carrigan & Coppola, 2012; 2017) causality (Rissman & Goldin-Meadow, 2017), semantic relation (Goldin-Meadow & Feldman, 1977), and displacement (Butcher, Mylander, & Goldin-Meadow, 1991). The extensive body of literature documented the gestural patterns that homesigners and their hearing interlocutors presented. As listed above, these patterns across diverse properties were compared to test whether the structural aspects of these gestural communication systems can be traced to the language input. Most of the studies compared homesigners and their potential source of input: mothers. The assumption was that if a child presents the same pattern as the mother, the pattern must have been acquired from the mother. Contrarily, if their patterns diverge, the child must have generated this structure.

In the first homesign studies, Goldin-Meadow and her colleagues examined the role of mother-child interaction in the creation of homesign systems (Butcher et al., 1991; Goldin-Meadow & Feldman, 1977; Goldin-Meadow & Mylander, 1983). They examined semantic relations, word order, complex sentences, and displacement patterns. The findings consistently demonstrated discrepancies between the patterns of the children and those of their mothers. Additionally, deaf children mostly went beyond the structural complexity of their mothers' patterns and produced more

complex linguistic constructions. Specifically, Butcher et al. (1991) conducted a longitudinal study to investigate the ability to refer to absent objects and events. The researchers discovered that a deaf child, David, consistently employed pointing and characterizing gestures to indicate non-present objects and events. Moreover, they analyzed the gestures of David's mother. Although she produced fewer gestures, David's mother also employed pointing and characterizing gestures to refer to the non-present in the early stages of their interactions. They considered that David might have exploited this maternal input to use gestures to indicate non-present objects and events by observing his mother. Even though the mother did not produce all types of gestures to refer to non-present referents, and David used more diverse gestures later in their communication, the researchers still argued that "David may well have needed a model to realize that gesture could be used to communicate about the non-present." (p. 335). In conclusion, the study suggested that certain properties of language may be central to human communication and might not require a conventional model to emerge. Also, for other properties of language, like referring to non-presents, input may be crucial to exceed the threshold of emergence (Goldin-Meadow, 2020; Rissman et al., 2020).

Following the studies in the US, researchers also compared homesign systems created in other cultures. For instance, Wang et al. (1993) investigated the effect of maternal input on children's production across the US and Chinese cultures. The results did not provide supporting findings for the effect of input on the children's gesture patterns. Chinese and American children produced more complex gesture sentences (containing more than one proposition) than their mothers. Conversely, it is found that Chinese children and mothers produce more gestures into their strings than American children and mothers do. In the Chinese sample, the amount of input

was greater and affected the output of the children. In this sense, the effect of culture was observed in productivity. In addition, Goldin-Meadow & Mylander (1998) investigated the word order patterns (actor, patient, act) of deaf children and their mothers within both cultures. Chinese mothers showed a tendency to order their gestures in a similar way to their children whereas American mothers did not. The researchers discussed two scenarios regarding how Chinese children and mothers might have followed similar patterns. Firstly, it was suggested that Chinese children might have acquired their word order patterns from their mothers. Unlike the American sample, Chinese mothers might have provided sufficient input. On the other hand, Chinese mothers might have adopted their children's patterns while American mothers did not. They concluded that the difference between the two cultures might derive from the level of gestural richness and attitude toward communication with deaf individuals.

In China, Yau (1992) also worked on two different cases which showed how gestural input and attitude toward deaf-hearing communication can change children's output. Yau examined two different homesign contexts, a 6-year-old homesigner boy and his parents and an 8-year-old homesigner girl and her parents. He documented that the homesigner boy displayed 294 signs in his interactions with his parents whereas the homesigner girl displayed only ten signs. Yau asserted that the difference between the attitudes of parents toward gestural communication resulted in this production gap between the two children. The parents of the deaf boy engaged in communication with their gestures and seemed to enjoy it, but the parents of the deaf girl avoided using any gestures and tried to teach her to speak. Yau emphasized the significance of attitude and input in the development of the gestural system even when both children and their parents lived in the same cultural context. Green (2022)

also highlighted the crucial role of a hearing person's orientation to deaf individuals in establishing mutual understanding.

The crosslinguistic homesign studies provided a more comprehensive perspective to explore whether linguistic properties are inherent to human language despite cultural differences. In another study, Goldin-Meadow et al. (2009) worked with Turkish, American, and Chinese homesigners to understand similarities and differences in word order and event segmentation patterns. They revealed that all deaf children positioned their gestures in sentences in the same order. The children had the ability for segmentation, combination, and organization. Özyürek et al. (2014) replicated this finding in their study on Turkish homesigners' manner and path patterns. Furthermore, Goldin-Meadow et al. (2015) conducted a comparative study between Turkish homesigners and their mothers, and American homesigners and their mothers. Their findings aligned with the previous results: homesigners went beyond the input they received. The interesting point is that Turkish mothers produced significantly more gesture sentences than American mothers. However, both Turkish and American deaf children used the same ordering pattern and segmentation strategy and exhibited more complex structures than their mothers. Even though their gestures did not seem to have an effect on children's patterns, Turkish mothers expressed their ideas more frequently compared to American mothers, in the same way Chinese mothers did.

In Nicaragua, Coppola and her colleagues investigated the homesigners and their family members (Carrigan & Coppola, 2012, 2017; Coppola, 2002; Coppola et al., 2013, Flaherty et al. 2021; Richie et al., 2014). Unlike the US, Nicaragua is characterized as a rich-gesture culture and Nicaraguan people frequently use their hands and body parts while they are communicating, especially with deaf individuals

(Flaherty et al., 2021). This cultural context offers more potential input for homesigners and a unique setting for researchers. Coppola and her colleagues primarily focused on various aspects such as complex noun phrases and sentences, numbers, comprehensibility, and conventionalization. They compared the gestures of Nicaraguan homesigners with the gestures of their mothers and the results showed that the source of linguistic structures is deaf children themselves, not the mothers. Flaherty et al. (2021) compared Nicaraguan and American homesigner children and their hearing family members to examine the patterns of their complex noun phrases and sentences. While their results are parallel with previous research, they noted that Nicaraguan participants significantly exhibited longer strings. This difference was attributed to cultural factors because both Nicaraguan children and their family members produced more gestures than their American counterparts did. This cultural difference aligned with the findings from the Chinese and Turkish homesign studies. Although children proportionately produced more complex phrases and sentences and hearing speakers did not offer a model for this, this cultural disparity suggested that the input might show variability across cultures and children can profit from it.

Some studies also focused on only homesigners and questioned whether deaf people without any model could present certain language properties (Coppola & Brentari, 2014; Coppola & Newport, 2005; Goldin-Meadow & Yang, 2017; Rissman & Goldin-Meadow, 2017). For example, Spaepen et al. (2011) drew attention to the counting abilities of Nicaraguan adult homesigners. These adult homesigners used gestures to convey numerical information, but their gestures did not correspond to exact values, but approximate values. Even though exact numbers are used frequently by society, it was insufficient for homesigners to create precise number representations. In another study, Hunsicker & Goldin-Meadow (2013) focused on

David and revealed that he used different handshapes to distinguish between nouns and verbs. This discovery reflected the noun-verb distinction found in emerging and established sign languages. It proved that some language characteristics are fundamental to language and can arise even in the lack of input.

Franklin et al. (2011) also worked on David and examined his utterances expressing negation and questions across eight play sessions that were recorded in 1970s. They hypothesized that if homesign has a basic syntax, it must have negation and question operators to modify sentences. Negation and question gestures were coded based on their type and form. The study aimed to analyze what kind of forms David would present and their positions within the multi-gesture sentences. Particularly, negation forms included nonmanual gestures (side-to-side headshake) and manual gestures (palm swipe away from the body, manual flip, and shrug of the shoulders). The results showed that David used side-to-side headshakes to negate sentences in 84% of his negation production (276 of the 327 negation sentences he produced). In multi-gesture sentences, David produced 79% of his headshakes in sentence-initial position. The researchers concluded that David has a particular negation gesture that was syntactically distinct from other gestures and predominantly positioned at the beginning of the sentences. Thus, it was implied that deaf children could develop negation markers without a conventional language model. However, researchers assumed that “David seemed to co-opt the headshake and flip forms used by hearing gesturers in his culture and use those forms to convey negative and question meanings, as do hearing gesturers.” (p. 410). Indeed, I propose that further investigation into negation gestures of hearing gesturers is required to determine whether the headshake was adopted from the surrounding community. In addition to this, investigating the negation patterns of communication partners is

essential to eliminate the possibility that negation gestures of hearing speakers already have a syntactic structure and serve as a model for the child.

1.5 The current study

Negation is one of the fundamental characteristics of human language, existing in all linguistic diversity of mankind (Dahl, 1979). Infants use head movements to express their negative intent before they learn the negation structure of the language used in their environment (Andr  n, 2010; Guidetti, 2005). Regardless of the amount and modality of input, all infants used side-to-side headshakes to express negation in the first year of their lives (Van Loon, Pfau, & Steinbach, 2014). The origin of this universal pattern of headshakes was attributed to the breastfeeding experience of infants (Spitz, 1957). During breastfeeding, the infants turn their heads in the opposite direction from their mother's breast when they are saturated with nutrition. According to Spitz, repetition of this movement turns into headshakes, and it is used for negative purposes for around 12 months. However, their negating behaviors change over time as they are exposed to conventional language input. As hearing children enhance their verbal abilities, they become more proficient in the conventional language spoken around them and their gesture usage decreases around the ages of 2 to 3 (McNeill, 2014). On the other hand, deaf children begin to use negation signs provided to them by the surrounding deaf community. If they are exposed to a grammatical headshake by their linguistic society, as in ASL, they adopt this new linguistic structure and abandon the utilization of the previous meaning (Anderson & Reilly, 1998). In addition to headshake, Boutet, Blondel, Beaupoil-Hourdel, and Morgenstern (2021) also showed that two types of negation gestures,

index-wagging (1-handshape) and palm-up are apparent in all children's negation expressions regardless of language and modalities they have.

There is no previous study examining Turkish hearing individuals' co-speech negation gestures. Thus, it is unknown how Turkish infants and children use negation gestures during their early years and through their speech. However, the various negation signs used in Türk İşaret Dili (TİD, Turkish Sign Language) have been documented since the beginning of the 2000s (Gökgöz, 2011; Makaroğlu, 2021; Zeshan, 2004, 2006). Turkish deaf infants and children are exposed to a variety of manual and non-manual negation signs if TİD is used in their immediate environment. TİD signers use 1-handshape, 5-handshape, wrist bending, and palm-up as manual negators and headshake, backward head tilt, single head turn, brow raising, and brow lowering as nonmanual negators (Gökgöz, 2011; Makaroğlu, 2021). Makaroğlu (2021) conducted a comprehensive study on negation gestures and patterns of Turkish deaf people who used TİD in different parts of Turkey. This corpus-based study showed that TİD signers actively utilized both manual and nonmanual negation signs and frequently combined these negatives as a strategy. This highlights that a Turkish deaf child could demonstrate diverse negation patterns if they acquire TİD naturally through input.

The current study explores what happens when a Turkish deaf child encounters the scarcity of conventional language input for negation. Following a prior study by Kan et al. (2022), which examined a Turkish deaf child's and his family members' patterns separately, I scrutinize these patterns between family members by focusing on a pairwise comparison of the child and his communication partner in the current study. Specifically, one of the main goals was to discover the homesigner child's negation gesture patterns if any. Another main goal was to

observe whether the gestures of the homesigner's family members presented a usable negation model for the deaf child. In this way, the child's patterns were discovered in association with the patterns of his communication partner.

In a previous study, Franklin and colleagues (2011) examined the negation patterns of David. They argued that David's negation expressions reflected his ability to reinvent the negation marker in the absence of a language model. However, negation gestures of hearing individuals around David were not assessed to ensure that they did not constitute a negation model for him. Therefore, to my knowledge, the effect of linguistic input on negation in a homesign system remains unexplored.

To address this matter, I examined the negation patterns of a 6-year-old Turkish homesigner child and his family members. The child had severe hearing loss that prevented him from acquiring a spoken language and he was not exposed to any sign language input. The focus was on the gestural communication between the deaf child, his hearing mother, and his hearing sister during play sessions. My purpose was to determine whether specific negation gestures were used, and if so, the forms in which they appeared, and whether they demonstrated consistency across various parameters. This study was the first of its kind as a negation study conducted within the homesign context in Turkey.

Similar to Franklin et al.'s (2011) study, the gestures were coded based on their forms. The analysis included the negation gestures in terms of form type, the manner and frequency of different forms, simultaneous production, combination, and positions in multi-gesture strings. This investigation allowed for a comparison of the data of the Turkish homesigner child with that of David in Franklin et al.'s (2011) study. Thus, this cross-homesign comparison enabled us to detect if any universal patterns of negation exists despite cultural differences.

The investigation focused on whether a consistent pattern existed in the negation gestures of a deaf child, his mother, and his sister and if so, the similarities and differences between their patterns. Specifically, the following research questions were addressed:

1. If there is a consistent pattern in the child's negation productions, what factors contribute to this pattern?
2. If there is a consistent pattern in the mother's and/or sister's negation productions while interacting with the child, how do these productions influence the child's use of negation?
3. What are the underlying reasons for the differences and similarities in the negation patterns produced by family members?

It was hypothesized that if the child used negation gestures similar to those of the mother and sister, it may suggest that the child adopted these gestures from his environment. This would support the assumption of the co-opting behavior of David and show that homesigner children can borrow co-speech gestures of hearing interlocutors and use them in their system. However, if the child's gestures differ from those of the mother and sister, it may indicate that the child did not borrow these gestures but created them independently. This would demonstrate that homesigner children can generate the system on their own, regardless of the input.

CHAPTER 2

METHODOLOGY

The data for the current study came from a previous project on homesign systems (Goldin-Meadow et al., 2009) that aimed to investigate homesign systems in four countries: Turkey, Spain, China, and the USA between 2000 and 2009. The data collection adhered to the ethical guidelines of NIH in the USA, and consent forms were obtained from the parents of the children involved. Caregivers/parents were compensated for their participation and children received toys.

2.1 Participants

The current study was conducted with a Turkish homesigner child and his hearing family, in Istanbul, Turkey, in 2008. The data consisted of his interactions with his hearing family members, namely, his mother and sister. Turkish was the home language.



Figure 1. Family members

At the time of the study, the homesigner child, referred to as ‘Deniz’, was six years old (Figure 1). He was born in 2002, in İstanbul. His severe hearing loss (with an unknown etiology) prevented him from learning any spoken language, Turkish in

this context. He did not have a cochlear implant. At the time of data collection, he had been receiving speech therapy for almost a year, but his speech production was limited to a few sounds. For example, he produced the sound 'am' to say 'Tamam' (okay) and shaped his mouth to produce the 'a' and 'i' sounds to say 'hayır' (no) and the 'o' and 'k' sounds to say 'yok' (absent). At other times, he only produced some sounds to react. For example, he screamed when he was angry, or he produced high-pitched voices when he was upset. However, there was no use of any spoken language other than these vocalizations. His speech comprehension was also limited to a few words (“tamam” *okay*, “hayır” *no*, “evet” *yes*, etc.) and he cannot lip-read except these words.

When the recording was made, he was not exposed to any conventional sign language and had also not attended any schools. He did not have contact with any deaf children or adults.

In Turkey, standardized cognitive assessments for deaf children were limited during study time. The researchers gave Deniz age-appropriate puzzles to assess his cognitive development stage. After the puzzle set and closely observing Deniz for home visits, the researchers detected no notable cognitive or social impairments. For instance, when his mother told him to gather the toys and put them in a bag, he easily complied, despite his reluctance to finish the playtime. When he was asked to describe past events, he comprehended the referent and tried to explain. While interacting with his sister, he engaged in role-play and easily took different roles.

The mother and the sister were present during the research. The mother was 42 years old and had two children, our homesigner child ‘Deniz’ and his 13-year-old sister (Figure 1). The mother did not have a full-time job but occasionally worked part-time to cover household expenses. She predominantly stayed at home and

dedicated her time to household responsibilities and caring for Deniz. The sister was born in 1995 and she was continuing her middle school education during the study. Since Deniz did not have peers other than his sister, they frequently played games and engaged in activities together.

The mother and the sister did not have any hearing or cognitive impairments. They had not previously learned or been exposed to sign language and had no social connections with the deaf community. There were no deaf individuals among their relatives.

2.2 Procedure

The study aimed to observe and document Deniz's natural interactions with his family members. To achieve this, a procedure commonly used in homesign literature was adopted (Goldin-Meadow & Feldman, 1977; Feldman et al., 1978; Goldin-Meadow, 1979; Wang et al., 1993; Goldin-Meadow, Butcher, Mylander, & Dodge, 1994; Goldin-Meadow, & Mylander, 1998). The data collection process involved home visits to investigate the family's communication dynamics in the home environment. The purpose of this procedure was to stimulate the elicitation of gestural communication with a set of toys during the video recording. During the process, the researcher was an observer and moderator with minimal intervention if necessary.

The visiting schedule was planned based on the available times of the family. The visits took place at six different times. Two researchers were present at all sessions; one researcher videotaped play sessions and the second researcher interacted with the family when needed.

It was anticipated that Deniz might use different gestures when interacting with the researcher compared to his interactions with his family members. This assumption was based on the thought that Deniz might perceive the researcher as incapable of understanding his gestures without a shared background. The researcher played games with Deniz in the beginning of first sessions to ensure that he does not hesitate to interact freely in the following sessions. Nonetheless, Deniz's interactions with the researcher remained limited. He generally communicated with the researcher through pointing gestures and needed a family member to understand or respond to the researcher's attempts while communicating.

The recordings were made in the brightest room of the house. During the play sessions, the family members sat on the ground and faced the camera. The researchers sat behind the camera and asked about interactions that occurred outside the camera or gestures that could not be interpreted. Our impression was that Deniz, his mother, and his sister maintained their natural behavior in front of the camera. Thus, our samples reflect their usual communication dynamics.



Figure 2. Examples of toy sets

During the visits, various toy sets and picture storybooks were provided to the family to enhance interactions. These toy sets consisted of a color-matched door-lock

set, building materials set, organs and accessories set on a Potato man, a set of toy furniture for a doll house, a city building set, a play dough set, and superheroes such as Batman and their accessories.



Figure 3. Play sessions

Each play session lasted approximately 45 to 60 minutes, considering Deniz's needs, attention span, and the family's availability. The total duration of six sessions was 298 minutes (Table 1). The first three sessions lasted 138 minutes. In these sessions, the mother was present, and the total interaction between the mother and the child was 70 minutes. The last three sessions lasted 160 minutes. In these sessions, the sister was present and the total interaction between the sister and the child was 126 minutes (Figure 3). Overall, the child interacted with the mother and sister for 196 minutes.

Table 1. The Details of the Sessions

Session Number	Session Date	Total Duration (minutes)	Family Members	Interaction Duration (minutes)
1	May 10th 2008	16	Child Mother	16
2	May 17th 2008	34	Child Mother	14
3	June 8th 2008	88	Child Mother	40
4	August 9th 2008	62	Child Sister	28
5	August 30th 2008	61	Child Sister	61
6	September 14th, 2008	37	Child Sister	37

2.3 Data coding

I coded the gestures of the participants by using ELAN, an annotation software developed at the Max Planck Institute for Psycholinguistics in Nijmegen (Sloetjes & Wittenburg, 2008). For the study, my focus was on negation gestures. Other types of gestures were not considered. Nevertheless, to gain a comprehensive understanding of the context and to ensure that the meaning of negation was correctly detected, I included non-negation gestures around negation gestures.

As detailed below, the coding process began with identifying communication chunks for each session (Figure 4 for structural representation). Subsequently, I isolated gesture strings in the communication chunks. A communication chunk can contain one or more gesture strings. These strings were further broken down into smaller parts, named as gesture units. These units may contain one or more individual gestures produced simultaneously. The smallest component of communication chunks is the individual gesture. These individual gestures, produced

one or more at a time, constitute gesture units. The gesture units, whether standalone or conjoined with each other, constitute gesture strings. After I broke down communication chunks into smaller parts, I examined how gesture strings occurred. Specifically, I investigated whether they contained one gesture unit, named as single unit string (Gesture String 2 in Figure 4), or they contained two or more units sequentially conjoined with others, named as multi-unit string (Gesture String 1 and Gesture String 3 in Figure 4). In Figure 4, each box represents an individual gesture, with horizontal ordering indicating gestures produced consecutively and vertical ordering indicating gestures produced simultaneously.

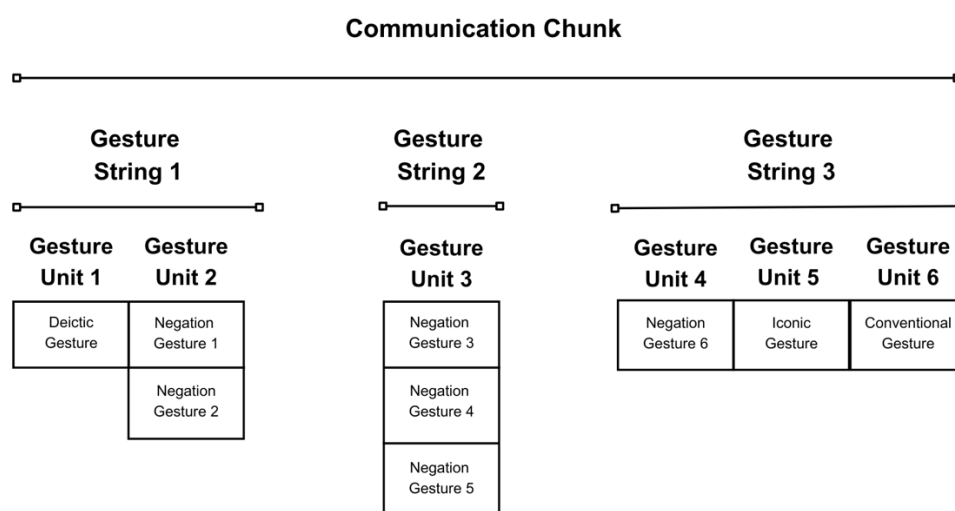


Figure 4. The structural hierarchy of communication chunks

Following the identification of gesture units (Goldin-Meadow & Mylander, 1984), I classified them into four categories: deictic, iconic, conventional, and negation. No additional parameters were coded for deictic, iconic, and conventional gestures. For negation gesture units, I coded their position within multi-gesture strings if these strings also contained gestures other than negation. I classified their position based

on their placement in the multi-unit string as string-initial, mid-string, or string-final. For each negation gesture unit, I coded its type based on the types of individual gestures it contained: manual only, nonmanual only, or a combination of manual and nonmanual. I further coded types of individual negation gestures in negation gesture units based on the form as manual gestures (1-handshape, 5-handshape, palm-up, wrist bending) and nonmanual gestures (headshake, backward head tilt, sideward head tilt, eyebrow-raising, eyebrow lowering, mouth gesture).

Through this coding process, the goal was to quantify each level of these parameters and calculate the number of occurrences and percentages to compare participants within their productions and with the productions of others.

2.3.1 Identification of communication chunks

The initial step of coding involved determining conversations that included negation expressions and their context. These conversations, communication chunks, contained gestural dialogues between Deniz and the mother or the sister. The communication chunk can contain one or more gesture strings (detailed in Section 2.1.3.2), but at least one of them must contain a negation expression. It starts with the first gesture of the first gesture string and ends with the last gesture of the last gesture string.

For example, during a play session, the mother pointed to one of the toys and asked, ‘What is this?’ (Figure 5a-b), and Deniz responded with ‘I do not know’ (Figure 5c). This conversation constituted a communication chunk. Following Deniz's response, they continued playing without producing negation gestures for a period. When another negation gesture occurred, we coded the context of this negation, which constituted another distinct communication chunk.



(a)



(b)



(c)

Figure 5. Communication chunk example

2.3.2 Identification of gesture strings

After the coding of communication chunks, I isolated gesture strings by using motoric criteria (Goldin-Meadow & Mylander, 1984, p. 18): “A relaxation of the body part(s) used for gesture production or the break (lasting two or more seconds) after a gesture unit or series of gesture units signaled the end of a string.” I segmented communication chunks based on uninterrupted and communicative gestural flows (Gesture String 1, 2, and 3 in Figure 4). For instance, if Deniz moved his hands or other body parts interchangeably without a break or relaxation of these body parts, I considered this continuous movement as a gesture string.

For example, in Figure 5, the mother pointed to one of the objects and opened her hand toward Deniz to ask, ‘What is this?’. She waited for Deniz’s response and did not move any part of her body for a while. This constituted the first string of the communication chunk (Figure 5a-b). Following the question from the mother, Deniz simultaneously tilted his head toward the left and raised his eyebrows to say, ‘I don’t know’. After Deniz responded to the question, he relaxed his body parts. This constituted the second string of the communication chunk (Figure 5c).

A gesture string can be either quick and simple communicative motions or continuous and different movements. These movements are subsequently defined as distinct pieces of a string: known as gesture units.

2.3.3 Identification of gesture units

The subsequent task was to define gesture units, distinct pieces of gesture strings. Goldin-Meadow and Mylander (1984) characterized a gesture as a continuous, uninterrupted flow of movement or a single motor unit. This motor flow is considered a gesture unit if there are no changes or breaks in the flow of movement.

After isolation, gesture strings were analyzed in terms of three dimensions: handshape, motion, and place of articulation to detect a change in the flow of movement. For example, when the mother first pointed to one object and then pointed to another object, these two pointings were counted as two separate gesture units if the place of articulation changed.

A break was defined as two or more seconds of pause between two movements. For instance, if the mother pointed to the same object several times, these pointings were regarded as distinct gesture units if there is an interval of two

seconds or more between each production. Repetition of the same gesture without a pause was treated as a single gesture unit.

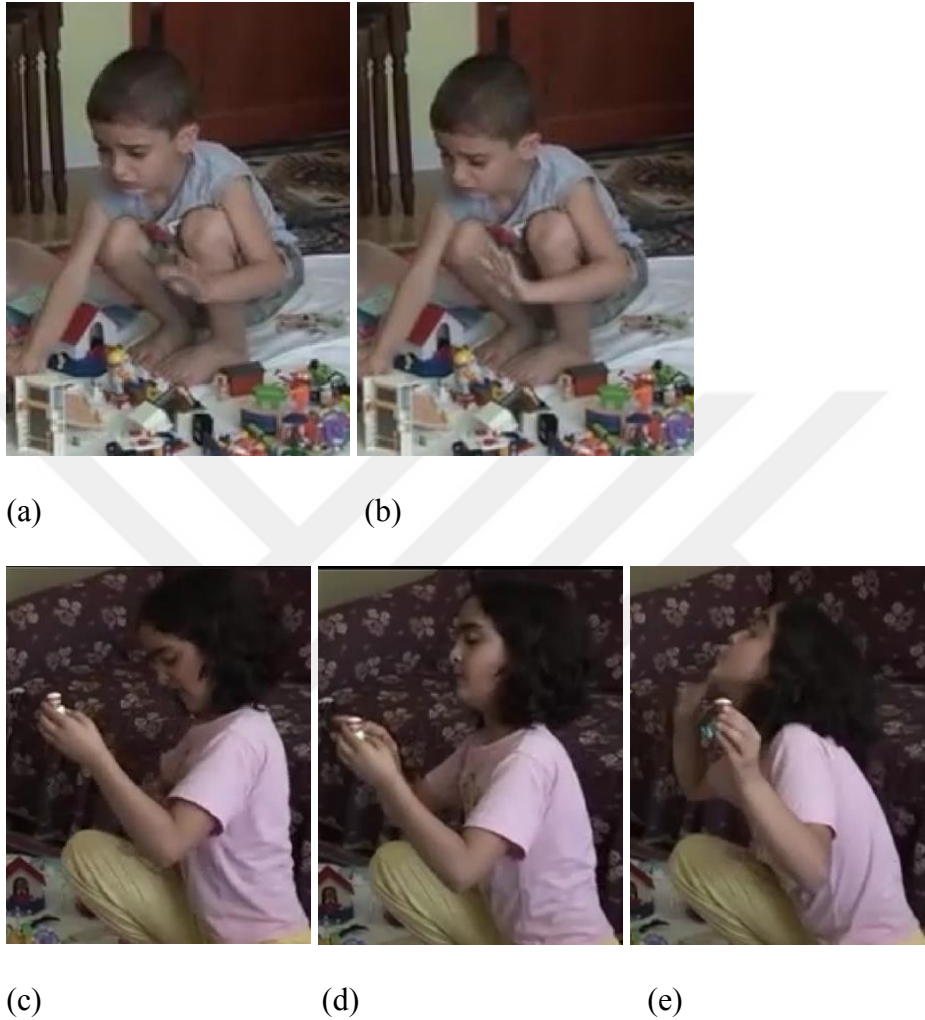


Figure 6. Examples of single-unit and multi-unit strings

A gesture string can contain a single gesture unit or two or more gesture units that must be produced without any breaks between them. I categorized gesture strings into two types based on the number of gesture units they contain:

- Single unit string: If the participant produced a single gesture unit and relaxed his/her hands or had a break of two or more seconds after the preceding gesture and before the following gesture, this constituted a single gesture string. For

example, Deniz simultaneously produced a headshake, 5-handshape variant, and brow lowering to say ‘No’ (Figures 6a and 6b are the beginning and end frames of a single unit string).

- Multi-unit string: If the participant produced two or more gesture units that were sequentially concatenated without relaxation or break, this constituted a multi-unit string. For example, the sister first produced an iconic gesture meaning spilling something over oneself (Figure 6c), then pointed to the toy (Figure 6d), and finally produced wrist bending, backward head tilt, and brow-raising at the same time (Figure 6e).



(a)

(b)

Figure 7. Examples of gesture units

In the scope of this study, the gesture unit may contain a single individual gesture or two or more individual gestures produced at the same time. For instance:

- The mother produces 1-handshape gesture (Figure 7a) without any accompanying gesture. She only produced one gesture at a time, and this individual gesture constituted a gesture unit.

- The sister produced wrist bending, backward head tilt, and brow-raising at the same time (Figure 7b). She produced three different individual gestures at a time and these gestures constituted a gesture unit.

2.3.4 Identification of gestures

My next aim was to identify gestures specifically produced for communicative intention and isolate them from the other movements of body parts. I used the following criteria to isolate individual gestures from the stream of motor behavior that family members produced (Feldman et al., 1978; Goldin-Meadow & Mylander, 1984): First, the motion must be directed to another individual. This criterion was met if the participant tried to establish eye contact with the communication partner. Unless there was an ongoing conversation, continuous eye contact was expected to initiate and sustain communication. If there was an ongoing conversation, the participant may know that the other individual is paying attention, making eye contact was optional. Additionally, the participant might end the conversation by stopping eye contact while still producing gestures. Second, the gesture must not be a direct motor act on the partner or some relevant object. For instance, when Deniz's mother used a picking-up gesture to demonstrate how toys should be collected, this gesture conveyed a communicative intention. In contrast, when Deniz performed a picking-up action, it did not convey any communicative intention because he just changed the toy's location without eye contact or conveying a message. Third, a gesture must not be part of a ritual act, such as opening palms to pray.

Individual gestures that met the criteria above were coded as distinct gestures and were part of gesture units and strings. For instance, wrist bending, backward head tilt, and brow-raising were coded as distinct individual gestures (Figure 6e).

However, if Deniz used his pointing finger to organize toys without a communicative intention, it was not coded as a gesture.

2.3.5 Classification of gesture units

Gesture units were classified into one of four categories (Goldin-Meadow & Mylander, 1984):

- Deictic gestures indicated objects, people, and locations in the immediate environment, and their meanings are context-bound. There are two types of deictic gestures:
 - Hold-up gestures: the participant holds up an object to convey a message in the partner's view. For example, the mother showed the toy before she asked 'Is this an ear?' (Figure 8a).
 - Pointing gestures: the participant extends a finger or palm toward an object (Figure 5a and Figure 6d).
- Iconic gestures described actions or attributes of concrete or abstract referents via hand or body movements. For example, the sister used her hands to describe a motorbike (Figure 8b).
- Conventional gestures included hand and body movements that were associated with conventional meanings in Deniz's community. For example, the mother used her pointing finger to say 'shush' (Figure 8c).
- Negation gestures included manual (Section 2.1.3.8) and nonmanual (Section 2.1.3.9) gestures used to reverse the truth value of a phrase or string. When the negation gesture is used in the periphery of the structure, it changes the direction of the message oppositely. The proposition or sentence was taken and turned into reverse meaning. For example, if the negation gesture is used in the unit, it would

add ‘not, do not, no’ meaning. In our study, negation gestures convey these meanings in various forms described in Sections 2.1.3.8 and 2.1.3.9.



(a)

(b)

(c)

Figure 8. Gesture unit classifications

2.3.6 Position of negation gesture units

The position of negation gesture units was coded for multi-unit strings that contain at least one negation and one non-negation gesture. The position was not coded for the single-unit strings and the multi-unit strings that contained only negation gesture units.

I categorized the position of negation into three types:

- String-initial: If the negation gesture was produced at the beginning of the string, it was coded as string-initial. For example, after the sister asked Deniz, ‘Is this your toy?’ he realized the researcher was watching them. He turned to the researcher, shook his head and hand, and raised his eyebrows (Figure 9a). Following this, he pointed to himself (Figure 9b) to say, ‘Not mine.’ This string begins with a negation gesture.

- Mid-string: If the negation gesture was produced between two non-negation gestures, it was coded as mid-string.
- String-final: If the negation gesture is produced at the end of the string, it is coded as string-final. (Figure 6e)



(a)

(b)

Figure 9. String-initial position example

2.3.7 Types of negation gesture units

Gesture units were categorized based on the types of gestures they contain:

- Manual-Only: If the negation gesture unit contained only a manual negation gesture, it was coded as manual-only. Manual-only gesture units can contain only one manual negation gesture at a time (9b).
- Nonmanual-Only: If the negation gesture unit contained only nonmanual negation gesture(s), it was coded as nonmanual-only. Nonmanual-only gesture units can contain two or more nonmanual negation gestures.
- Manual-Nonmanual Combination: If the negation gesture unit contained both a manual negation and a nonmanual negation gesture, it was coded as a combination (Deniz in Figure 9a).

2.3.8 Classification of manual negation gestures

Manual negation gestures were negation expressions produced by hands. Manual negation gestures were classified based on their forms:

- 1-handshape variants were produced by extending an index finger, palm facing out, and shaking it with a side-to-side movement. Only the index finger was extended while the other fingers were curled into a fist, closed, or partially closed. The thumb was opposed and closed so the thumb restrains the middle finger. This handshape had two-handed and one-handed variants. In Figure 10, a, b, and c are different frames from the same 1-handshape gesture of Deniz while d and e are also different frames from the same 1-handshape gesture of the sister.

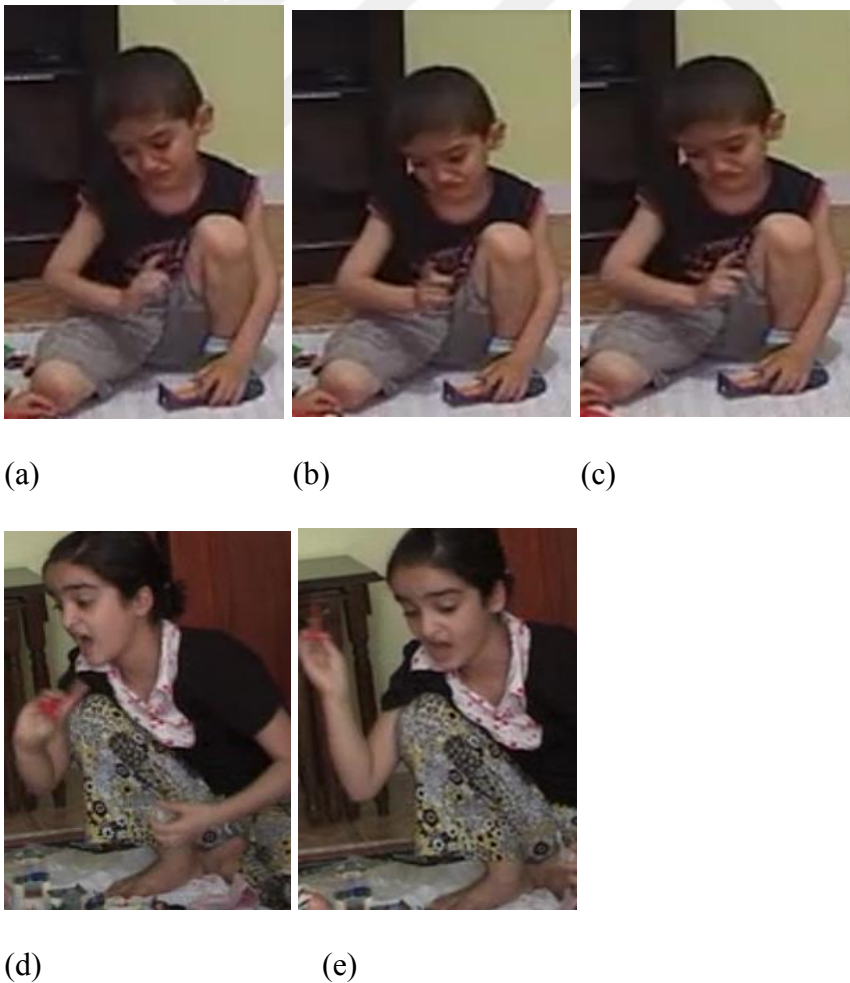


Figure 10. Examples of 1-handshape variants

- 5-handshape variants were produced by extending the hand, palm facing out, and a repeating side-to-side movement. This handshape usually involved all fingers extended upright and spread apart (Figure 11c-d). The hand was generally open and relaxed, and the fingers were usually spread wide. This handshape had two-handed and one-handed variants as well. For example, the sister initially pointed to Deniz (Figure 11a), then she produced an iconic gesture representing smoking (Figure 11b) and then used the 5-handshape variant with both hands (Figures 11c and 11d are the beginning and end frames of the same gesture) to express 'Do not smoke!'.



(a)



(b)



(c)



(d)

Figure 11. Example of 5 handshape variants

- Palm-up: Zeshan (2004) highlighted various non-manual markers in T1D associated with palm-up signs that indicate a negative function: headshake, backward head tilt, and brow lowering. This study also examined the context to determine whether the palm-up gesture conveys a negative meaning (see Section 2.1.3.10). I categorized palm-up gestures as expressing negation when they co-occurred with other nonmanual negation gestures while also benefiting from contextual cues.
- It described a hand configuration: the palm was open, facing upward, and all fingers were loosely extended. The gesture involved a lateral separation of the two hands (or a lateral movement of one hand) or a movement toward the interlocutor. This handshape had two-handed and one-handed variants. For example, Deniz produced a palm-up gesture with one hand (Figure 12a) and two hands (Figure 12b) to express ‘I don’t know.’



(a)

(b)

Figure 12. Examples of palm-up gestures

- Wrist-bending was an outward twist of the wrist joint ending in an open handshape. It consisted of full wrist bending, bringing the fingers from facing downwards to facing upwards. This handshape had two-handed and one-handed variants. For example, to negate her string, the mother used wrist bending at the end of her string (Figures 13a and 13b are the beginning and end frames of the same gesture.)



(a)

(b)

Figure 13. Wrist bending example

- Other: Manual gestures that did not fall into the four categories defined above are categorized as 'other'. These gestures were infrequent, and their occurrence was relatively low. For instance, Deniz used the palm down gesture, that is, palm(s) facing downward and moving horizontally through space, either along the lateral axis or diagonally downward, to indicate the absence of the toy. For example, Deniz used a palm-down gesture to express, 'The toy is lost.' in Figure 14 (a and b are the beginning and end frames of the same gesture).

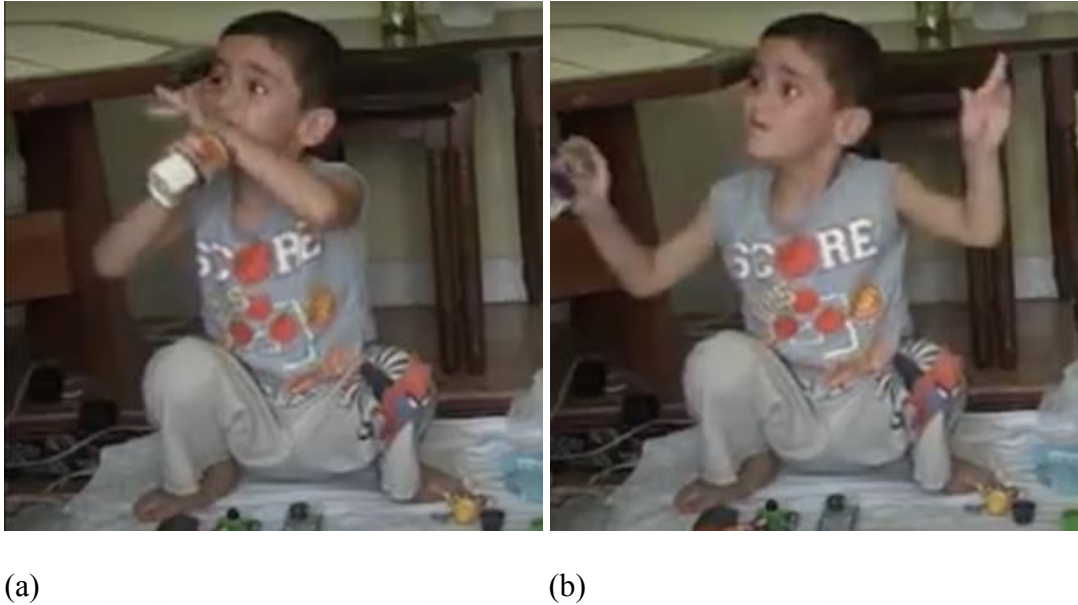


Figure 14. Other gesture example: palm down

2.3.9 Classification of non-manual negation gestures

Non-manual negation gestures included facial expressions, and head and body movements. In contrast to manual gestures (i.e., only one is produced at a time), non-manual gestures can be produced simultaneously. Given that there were instances where up to three different non-manual gestures were produced concurrently, I included these simultaneous productions in the coding process.

Non-manual negation gestures were classified based on their forms:

- Headshake involved moving the head from side to side. For example, Deniz shook his head to reject what his interlocutors offered to him (Figures 15a and 15b are the beginning and end frames). Once again, I followed the same procedure for classifying negative palm-ups and investigated accompanying gestures and context to classify a headshake as a negation.



(a)

(b)



(c)

(d)

Figure 15. Negation head forms

- A backward head tilt involved a subtle movement in which the head tilted backward, typically performed slowly and deliberately. For example, the mother tilted her head back to express, ‘Do not do that.’ (Figure 15c).
- Sideward head tilt involved laterally tilting the head to one side. It was usually produced to express uncertainty with palm-up and brow-raising. Deniz tilted his head to the side to express ‘I don’t know.’ (Figure 15d).



(a)

(b)

(c)



(d)

(e)

Figure 16. Nonmanual negation forms

- Brow-raising was a rapid upward movement of both eyebrows. It was usually used with other nonmanual negation gestures, such as backward head tilt, mouth gestures, and shoulder shrugs (Figure 16a-b).
- Brow-lowering involved lowering both eyebrows (Figure 16c). It was usually used with other nonmanual negation gestures such as headshake and mouth gestures.

- Mouth gesture involved lowering the lower lip while expressing uncertainty. It was produced with a sideward head tilt and/or palm-up gesture (Figure 16d-e).
- Non-manual gestures that did not fall into the six categories defined above were categorized as 'other'. These gestures were also infrequent. For instance, Deniz sometimes shrugged his shoulders simultaneously using a palm-up, brow-raising, and mouth gesture to say, 'I do not know' (Figure 16e).

2.3.10 Interpretation of gestures

As the gesture system of the family was not a conventional system shared by a community of users, my interpretations were essentially best guesses about the child's intended meaning. The context, interlocutor responses, and Deniz's reactions to those responses played an important role in shaping my interpretations (Franklin et al., 2011). One of the researchers persistently monitored the communication between family members. She asked the mother or sister to clarify what the gesture, gesture unit or gesture strings mean if the expression was not familiar. Therefore, I benefitted from descriptions of the mother and the sister.

2.3.11 Interrater reliability

For interrater reliability, I shared a data coding template with a deaf researcher and gave training. The data codings of negation gestures were conducted by me and the deaf researcher separately. Our codings were compared to calculate interrater reliability. Interrater agreement was:

- 95% (559/586) for identification of manual and nonmanual negation gestures ($\kappa = .885$, $p < .001$),
- 97% (232/240) for identification of negation gesture units ($\kappa = .933$, $p < .001$),

- 96% (219/229) for identification of negation gesture strings ($\kappa = .912$, $p < .001$.),
- 94% (549/586) for classification of manual and nonmanual negation gestures between two coders ($\kappa = .845$, $p < .001$.).

In summary, these Kappa values suggested a very high level of agreement between the two coders in their coding of the data.



CHAPTER 3

RESULTS

The results section of the study include presentations of frequencies and percentages for each parameter and each family member. Specifically, the terms 'string,' 'unit,' and 'gesture' were utilized if they contained a negation expression.

We identified a total of 151 communication chunks each of which contained at least one negation gesture. These communication chunks contained 229 gesture strings across all family members. These strings contained 240 gesture units that comprised 586 individual gestures (see Figure 4 for structural representation). I elaborate on the details of these strings, gesture units, and individual gestures in the following sections.

Within these sections, I provide the number of occurrences and percentages for gesture string types, negation positions, gesture unit types, manual gesture types, and nonmanual gesture types for each family member. Additionally, I separate Deniz's negation expressions into two parts based on his sessions with his mother and his sister for a more detailed analysis. Hence, I present three distinct sets of results for Deniz:

- 'Child total' involved all six sessions.
- 'Child-with-mother' involved the first three sessions where Deniz interacted with his mother.
- 'Child-with-sister' involved the last three sessions where Deniz interacted with his sister.

Table 2. The Summary of the Gesture Production for Each Family Member

Person	Interaction Duration (minutes)	Total Gesture Number	Gesture Number per minute	Gesture Number per unit
Child Total	196	288	1.47	2.28
Child with Mother	70	108	1.54	2.57
Mother	70	200	2.85	2.67
Child with Sister	126	180	1.43	2.14
Sister	126	98	0.78	2.51

In 196 minutes, Deniz produced 119 gesture strings containing 126 gesture units which consisted of 288 individual negation gestures (Table 2). He produced an average of 1.47 negation gestures per minute, and simultaneously produced 2.29 negation gestures per gesture unit.

In the sessions with his mother, which lasted 70 minutes, Deniz produced 39 gesture strings containing 42 gesture units, which consisted of 108 negation gestures. He produced an average of 1.54 negation gestures per minute, and simultaneously produced 2.57 negation gestures per gesture unit. In contrast, in sessions with his sister, which lasted 126 minutes, Deniz produced 80 gesture strings containing 84 gesture units, which consisted of 180 negation gestures. He produced an average of 1.43 negation gestures per minute, and simultaneously produced 2.14 negation gestures per gesture unit. Although Deniz produced more total negation gestures during sessions with his sister, he produced more negation gestures per minute and simultaneously more negation gestures per gesture unit with his mother.

In 70 minutes, the mother produced 74 gesture strings containing 75 gesture units, which consisted of 200 negation gestures. On average, she produced 2.85 negation gestures per minute and simultaneously produced 2.67 negation gestures per gesture unit. On the other hand, in 126 minutes, the sister produced 36 gesture strings containing 39 gesture units, which consisted of 98 negation gestures. On average, she produced 0.78 negation gestures per minute and simultaneously produced 2.51 negation gestures per gesture unit. The mother produced more negation gestures per minute and gesture units than the sister did. Following the mother, Deniz produced more negation gestures per minute and gesture units in sessions with his mother than in sessions with his sister. Deniz exhibited variations in his production depending on his interaction partner. It indicated the effect of the interlocutor on his gesture production.

3.1 Gesture string type

In this section, I present the occurrences of different types of gesture strings for each family member and distinguish the occurrences for Deniz in sessions with his mother and sister. Table 3 provides a detailed breakdown of occurrences and percentages for each family member and Deniz's distributions with his mother and sister.

Table 3. Frequency Distribution of Gesture String Types across Family Members

Person	Single Gesture Unit	Multi-Gesture Unit	Total
Child Total	108 (91 %)	11 (9 %)	119 (100 %)
Child with Mother	36 (92 %)	3 (8 %)	39 (100 %)
Mother	44 (59 %)	30 (41 %)	74 (100 %)
Child with Sister	72 (90 %)	8 (10 %)	80 (100 %)
Sister	22 (61 %)	14 (39 %)	36 (100 %)

Deniz produced 119 gesture strings. 108 of them (91%) contained only one gesture unit, while the remaining 11 (9%) contained two or more gesture units. These 11 multi-unit strings contain 18 negation gesture units. Specifically, among these 11 multi-unit strings, five multi-unit strings contained one negation gesture unit, five multi-unit strings contained two negation gesture units, and one multi-unit string contained three negation gesture units.

While Deniz produced 36 single-unit strings (92%) and three multi-unit strings (8%) in sessions with his mother, he produced 72 single-unit strings (90%) and 8 multi-unit strings (10%) in sessions with his sister. The ratio of Deniz's single-unit strings and multi-unit strings remained consistent between the sessions with the mother and sister.

The mother produced 74 gesture strings. 44 of them (59%) contained only one gesture unit, while the remaining 30 (41%) contained two or more gesture units. 30 multi-unit strings contained 31 negation gesture units. Specifically, among these 30 multi-unit strings, 29 multi-unit strings contained one negation gesture unit, and

one multi-unit string contained two negation gesture units. She produced a total of 75 negation gesture units (44 in single-unit strings and 31 in multi-unit strings).

The sister produced 36 gesture strings. 22 of them (61%) contained only one gesture unit, while the remaining 14 (39%) contained two or more gesture units. 14 multi-unit strings contained 17 negation gesture units. Specifically, among these 14 multi-unit strings, 11 multi-unit strings contained one negation gesture unit, and three multi-unit strings contained two negation gesture units. She produced a total of 39 negation gesture units (22 in single-unit strings and 17 in multi-unit strings).

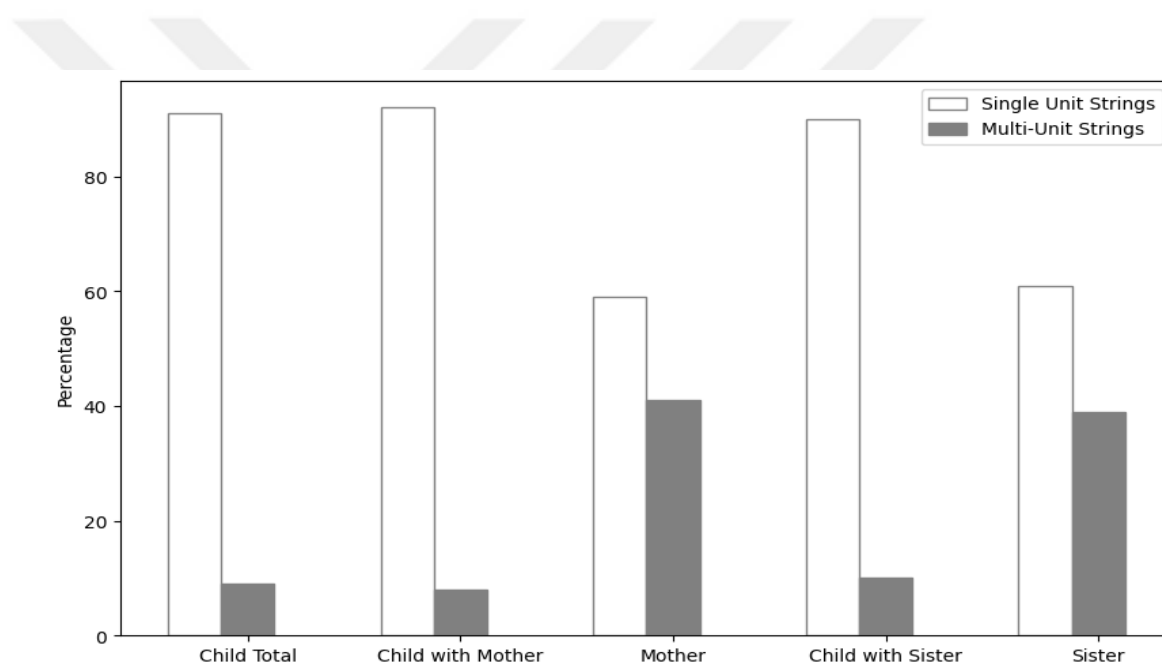


Figure 17. Percentages of gesture string types across family members

Deniz predominantly produced single-unit strings while the mother and sister showed a more balanced distribution between single-unit strings (59% and 61%, respectively, Figure 17) and multi-unit strings (41% and 39%, respectively). In summary, Deniz showed a limited ability to concatenate gesture units. In contrast, his mother and sister both demonstrated the capability to concatenate gesture units in their negation expressions.

3.2 Negation position

In this section, I present the occurrences of different types of negation positions for each family member and distinguish the occurrences for Deniz in sessions with his mother and sister. Table 4 provides a detailed breakdown of occurrences and percentages for each family member and Deniz's distributions with his mother and sister.

If a string contained only negation gesture unit(s), the negation position was not coded. For instance, while the single-unit strings did not have position information, the multi-unit strings containing only two or three negation gesture units also did not have position information. The negation gesture unit must be produced with at least one non-negation unit within the same string to have position information.

Table 4. Frequency Distribution of the Position of Negation Gesture in Multi-gesture Strings across Family Members

Person	Sentence	Mid	Sentence	Total
	initial	sentence	final	
Child Total	4 (36 %)	0 (0%)	7 (64 %)	11 (100 %)
Child with Mother	0 (0 %)	0 (0 %)	1 (100 %)	1 (100 %)
Mother	1 (3 %)	1 (3 %)	27 (94 %)	29 (100 %)
Child with Sister	4 (40 %)	0 (0 %)	6 (60 %)	10 (100 %)
Sister	2 (13 %)	0 (0 %)	13 (87 %)	15 (100 %)

Deniz produced 11 multi-unit strings which contained 18 negation gesture units. Among these, three multi-unit strings contained only negation gesture units. Specifically, there were two multi-unit strings containing only two negation gesture units and one multi-unit string containing only three negation gesture units. Thus, these seven units were not included in the analyses. However, position information was coded for the remaining 11 negation gesture units. Deniz produced four negation gesture units at the initial position (36%) and seven negation gesture units at the final position of the gesture strings (64%). There were no instances of negation gestures positioned in the middle of the string.

During interactions with his mother, Deniz produced one negation gesture unit positioned at the end of the string. When interacting with his sister, he produced ten negation gesture units. Four of them were positioned at the beginning and six at the end of the string. Even though the limited number of position information did not provide a chance to make strong inferences, all of Deniz's negation gesture units at the beginning of the string occurred in the sessions with his sister.

The mother produced 30 multi-unit strings which contained 31 negation gesture units. One multi-unit string contained only two negation gesture units, thus not included in the analyses. Position information was coded for the remaining 29 negation gesture units. The mother produced one negation gesture unit at the beginning (3%), one negation gesture unit at the middle (3%), and 27 negation gesture units at the end of the gesture strings (94%).

The sister produced 14 multi-unit strings which contained 17 negation gesture units. One multi-unit string contained only two negation gesture units, thus not included in the analyses. Position information was coded for the remaining 15 negation gesture units. The sister produced two negation gesture units at the

beginning (13%), and 13 negation gesture units at the end of the gesture strings (87%).

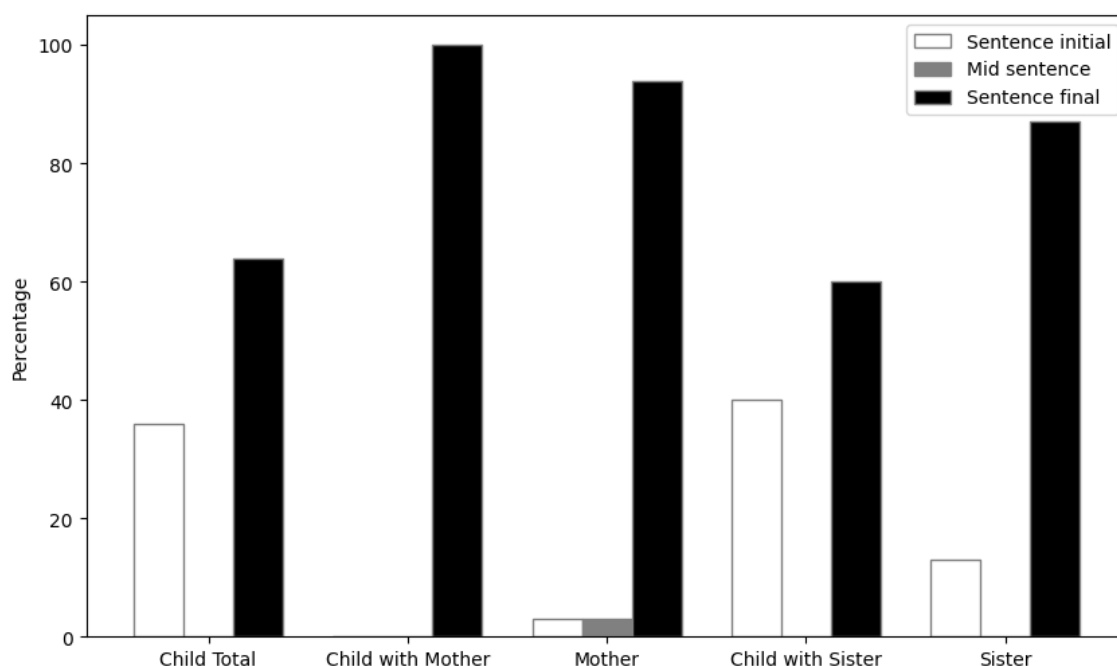


Figure 18. Percentages of the position of negation gesture in multi-unit strings across family members

As mentioned earlier, the number of instances with position information for negations was low. However, apart from one instance, all family members tended to produce negations either at the beginning or at the end of a string (Figure 18). Furthermore, they all most frequently placed negation gesture units at the end of multi-unit strings. Also, Deniz produced all his string-initial gesture units during the sister sessions which aligned with the sister's higher proportion of string-initial positions.

Additionally, the spreading behavior of negation gestures over other gestures was not observed in this study. Deniz, his mother, and his sister produced negation gestures in their respective gesture units. The negation gestures were not extending

over other negation gesture units or other types of gesture units (deictic, iconic, or conventional).

3.3 Gesture unit type

In this section, I present the occurrences of different types of gesture units for each family member and distinguish the occurrences for Deniz in sessions with his mother and sister. Table 5 provides a detailed breakdown of occurrences and percentages for each family member and Deniz's distributions with his mother and sister.

Table 5. Frequency Distribution of Gesture Unit Types across Family Members

Person	Manual + NonManual	Only NonManual	Only Manual	Total
Child Total	76 (60 %)	39 (31 %)	11 (9 %)	126 (100 %)
Child with Mother	20 (48 %)	21 (50 %)	1 (2 %)	42 (100 %)
Mother	53 (71 %)	21 (28 %)	1 (1 %)	75 (100 %)
Child with Sister	56 (67 %)	18 (21 %)	10 (12 %)	84 (100 %)
Sister	29 (74 %)	5 (13 %)	5 (13 %)	39 (100 %)

Deniz produced 126 negation gesture units. He used only manual gestures in 11 units (9%), only nonmanual gestures in 39 units (31%), and combined nonmanual and manual gestures in 76 units (60%). He predominantly relied on nonmanual gestures (91%, i.e. nonmanual involvement in manual+nonmanual and non-manual only combined).

During interactions with his mother, Deniz produced 42 negation gesture units. He used only nonmanual gestures in 21 units (50%), only manual gestures in one unit (2%), and combined nonmanual and manual gestures in 20 units (48%). During interactions with his sister, he produced 84 gesture units. He used only nonmanual gestures in 18 units (21%), only manual gestures in 10 units (12%), and combined nonmanual and manual gestures in 56 units (67%).

In interactions with his mother, Deniz predominantly used nonmanual gestures in 98% of his negation expressions (i.e. nonmanual involvement in manual+nonmanual and non-manual only combined). He produced only one negation gesture unit containing only a manual gesture. Conversely, during interactions with his sister, Deniz relied on nonmanual gestures in 88% of his negation expressions (i.e. nonmanual involvement in manual+nonmanual and non-manual only combined). He produced 10 negation gesture units containing only manual gestures. It constituted 91% of his total of only manual production (10/11). His predominant usage was a combination of nonmanual and manual negation gestures (67%), followed by only nonmanual gestures (21%), and lastly, only manual gestures (12%). Notably, there was a shift between sessions with his mother and sister. Specifically, there was an increase in the rate of only manual gestures from 2% to 12%, an increase in the combination rate from 48% to 67%, and a decrease in the only nonmanual rate from 50% to 21%. This implies that he used his hands more frequently in interactions with his sister compared to interactions with his mother.

The mother produced 75 negation gesture units. She used only nonmanual gestures in 21 units (28%), only manual gestures in one unit (1%), and combined nonmanual and manual gestures in 53 units (71%). Her predominant use was nonmanual gestures (i.e. nonmanual involvement in manual+nonmanual and non-

manual only combined), accounting for 99% of her negation expressions. There was one gesture unit containing only a manual gesture. In contrast, the sister produced 39 negation gesture units. She used only nonmanual gestures in five units (13%), only manual gestures in five units (13%), and combined nonmanual and manual gestures in 29 units (74%). Unlike the mother, the sister used manual gestures more frequently (13% only manual and 74% a combination of manual and nonmanual).

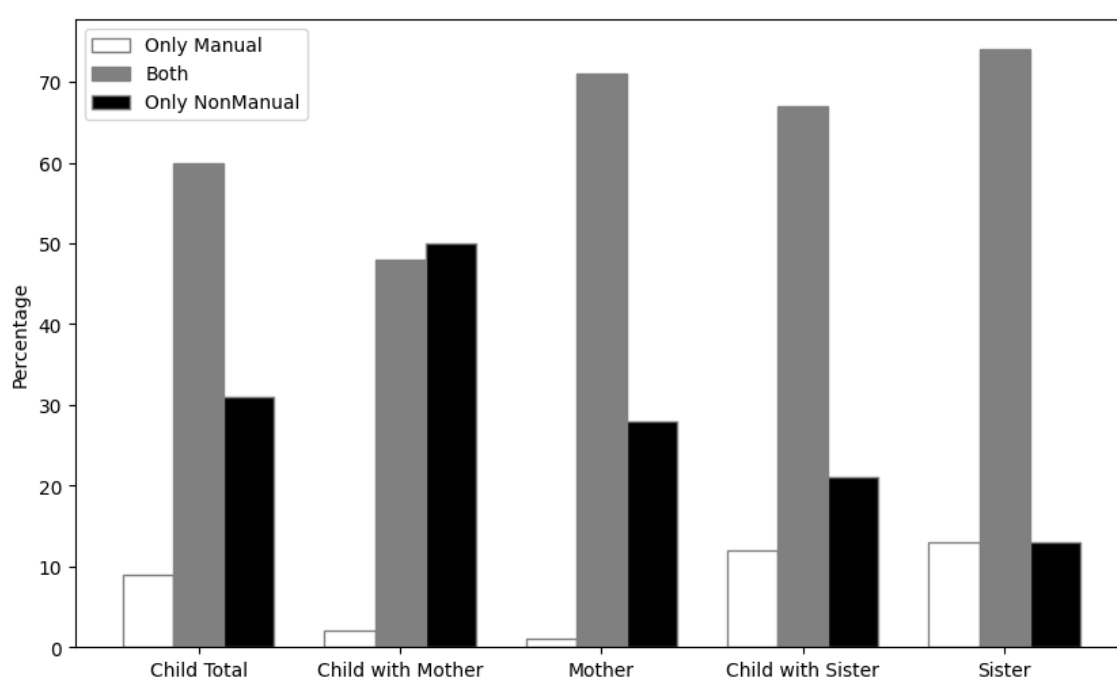


Figure 19. Percentages of gesture unit types across family members

In summary, Deniz exhibited variations in the rate of using manual and nonmanual gestures based on his interaction partner (Figure 19). When interacting with his mother, he used nonmanual gestures in 98% of his negation expressions, very close to his mother's usage (99%). Furthermore, both Deniz and his mother produced only one instance of a negation containing only manual gestures. However, Deniz's usage rate of only manual gestures increased from 2% to 12%, parallel to his mother's and sister's rates (1% and 13%, respectively). In short, Deniz used manual gestures in

50% of his negation expressions with his mother and 79% with his sister. This suggests that Deniz used his hands more frequently when interacting with his sister,

In conclusion, it was remarkable that all family members primarily utilized a combination of both nonmanual and manual gestures, followed by only nonmanual gestures, and lastly only manual gestures (except for the sister's equal rate of only manual and only nonmanual gestures).

3.4 Manual negation gestures

In this section, I present the occurrences of various types of manual negation gestures for each family member. Table 6 provides frequencies and percentages for each family member and Deniz's distributions with his mother and sister.

Deniz produced 87 manual gestures. His manual gestures included 16 1-handshape variants (18%), 40 5-handshape variants (46%), five wrist bendings (6%), 20 palm-ups (26%), and six other gestures (7%). Overall, Deniz predominantly used 5-handshape variants, palm-ups, and 1-handshape variants.

Table 6. Frequency Distribution of Manual Negation Forms across Family Members

Person	1-handshape variant	5-handshape variant	Wrist Bending	Palm-up	Other	Total
Child Total	16 (18 %)	40 (46 %)	5 (6 %)	20 (23 %)	6 (7 %)	87 (100 %)
Child with Mother	1 (5 %)	1 (5 %)	4 (19 %)	15 (71 %)	0 (0 %)	21 (100 %)
Mother	5 (9 %)	5 (9 %)	27 (50 %)	16 (30 %)	1 (2 %)	54 (100 %)
Child with Sister	15 (23 %)	39 (59 %)	1 (2 %)	5 (8 %)	6 (8 %)	66 (100 %)
Sister	19 (56 %)	5 (15 %)	7 (21 %)	3 (8 %)	0 (0 %)	34 (100 %)

In interactions with his mother, Deniz produced 21 manual gestures. These manual gestures included one 1-handshape variant (5%) and one 5-handshape variant (5%), four wrist bendings (19%), and 15 palm-ups (71%). During these sessions, Deniz mostly used palm-ups and wrist bendings. In contrast, in interactions with his sister, Deniz produced 66 manual gestures. These manual gestures included 15 1-handshape variants (23%), 39 5-handshape variants (59%), one wrist bending (2%), five palm-ups (8%), and six manual gestures classified as other (8%). During these sessions, Deniz mostly utilized 5-handshape variants and 1-handshape variants. Even though the number of manual gestures was low in mother sessions, it was evident that his manual production differed in mother and sister sessions.

The mother produced 54 manual gestures. Her manual gestures included five 1-handshape variants (9%), five 5-handshape variants (9%), 27 wrist bendings (50%), 16 palm-ups (30%), and one other gesture (2%). She predominantly used wrist bendings and palm-ups.

The sister produced 34 manual gestures. Her manual gestures included 19 1-handshape variants (56%), five 5-handshape variants (15%), seven wrist bendings (21%), and three palm-ups (8%). Unlike the mother, she predominantly used 1-handshape variants, wrist bending, and 5-handshape variants.

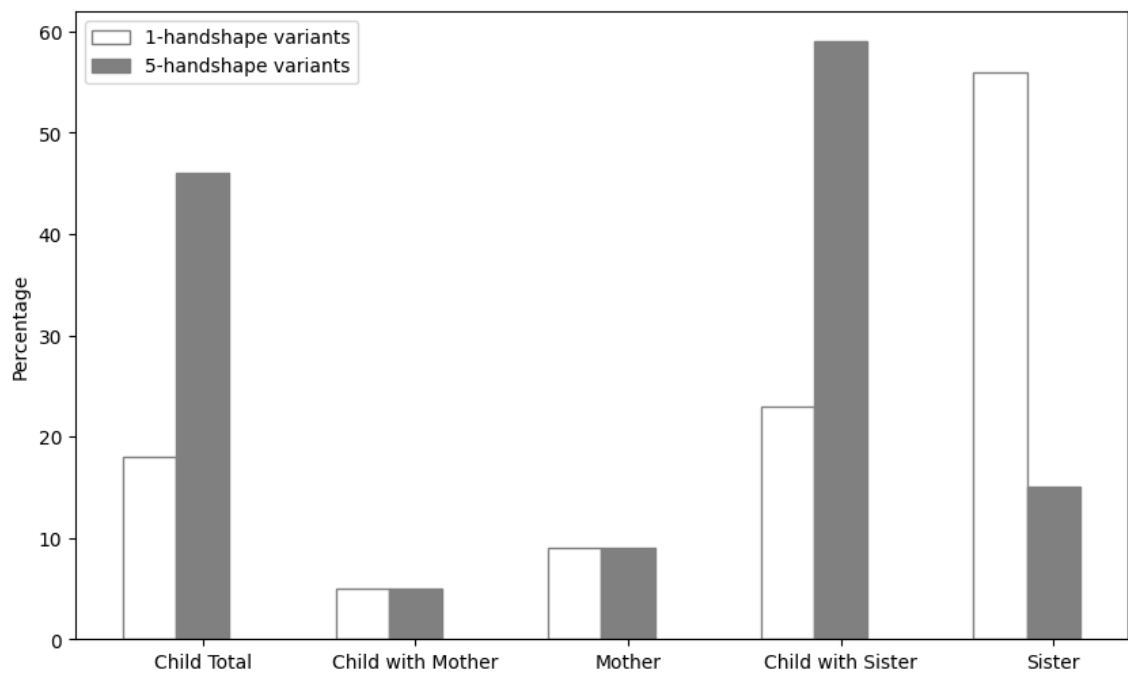


Figure 20. Percentages of 1-handshape variants and 5-handshape variants across family members

A similar pattern in the gesture unit type was seen in the rate of manual gesture usage. Deniz exhibited variations in manual gestures depending on his interaction partner. During sessions with his mother, he used manual gestures 19% of the time (21/108), while his mother used manual gestures 27% of the time (54/200). In contrast, in sessions with his sister, his use of manual gestures increased to 37% (66/180), mirroring his sister's rate of 35% (34/98). In summary, there was a noticeable correlation between Deniz's manual production rate and his communication partner's rate. This suggested an influence of the interlocutor on his manual production.

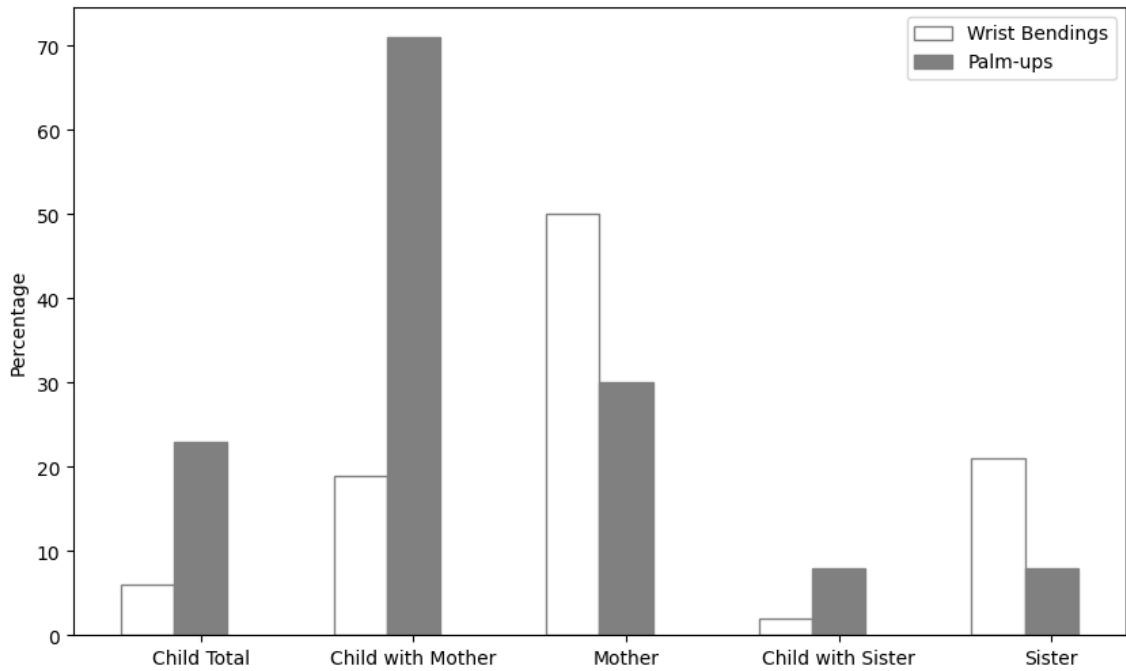


Figure 21. Percentages of wrist bendings and palm-ups across family members

In the distribution of manual gesture types, palm-ups, and wrist bendings constituted 90% of Deniz's manual productions in sessions with his mother and 80% of his mother's manual productions. Conversely, 1-handshape variants and 5-handshape variants constituted 82% of Deniz's manual productions in sessions with his sister and 71% of his sister's productions (Figure 20). Specifically, among Deniz's manual gestures, four out of five wrist bendings (80%) and 15 out of 20 palm-ups (75%) were observed with his mother, who predominantly used wrist bending and palm-up (Figure 21). In contrast, 15 out of 16 1-handshape variants (94%) and 39 out of 40 5-handshape variants (98%) were observed with his sister, who predominantly used 1-handshape variants and 5-handshape variants.

In conclusion, Deniz's manual production in sessions with his mother and sister differs from each other and he seems to adapt his manual gestures based on his interlocutor's manual gestures.

3.5 Nonmanual negation gestures

In this section, I present the occurrences of different types of nonmanual negation gestures for each family member and distinguish the occurrences for Deniz in sessions with his mother and sister. Table 7 provides a detailed breakdown of occurrences and percentages for each family member and Deniz's distributions with his mother and sister.

Table 7. Frequency Distribution of Nonmanual Negation Forms across Family Members

Person	Headshake	Backward head tilt	Sideward head tilt	Brow Raising	Brow Lowering	Mouth Gesture	Other	Total
Child Total	52 (26 %)	15 (8 %)	13 (7 %)	63 (31 %)	30 (15 %)	25 (12 %)	3 (2 %)	201 (100 %)
Child with Mother	8 (9 %)	14 (16 %)	13 (15 %)	32 (37 %)	6 (7 %)	12 (14%)	2 (2%)	87 (100 %)
Mother	24 (16 %)	42 (29%)	6 (4 %)	56 (38 %)	10 (7 %)	8 (6%)	0 (0%)	146 (100 %)
Child with Sister	44 (39 %)	1 (1 %)	0 (0 %)	31 (27 %)	24 (21 %)	13 (11 %)	1 (1 %)	114 (100 %)
Sister	15 (23 %)	10 (16 %)	1 (2%)	24 (38 %)	5 (8 %)	9 (14 %)	0 (0 %)	64 (100 %)

Deniz produced 201 nonmanual gestures. His nonmanual gestures included 52 headshakes (26%), 15 backward head tilts (8%), 13 sideward head tilts (7%), 63 brow raisings (31%), 30 brow lowerings (15%), 25 mouth gestures (12%) and three other gestures (2%). Overall, Deniz predominantly used brow-raising and headshakes.

In interactions with his mother, Deniz produced 87 nonmanual gestures. His non-manual gestures included eight headshakes (9%), 14 backward head tilts (16%), 13 sideward head tilts (15%), 32 brow raisings (37%), six brow lowerings (7%), 12

mouth gestures (14%) and two other gestures (2%). During these sessions, Deniz mostly utilized brow-raising, backward head tilts, and sideward head tilts. On the other hand, Deniz produced 114 nonmanual gestures. His non-manual gestures included 44 headshakes (39%), one backward head tilt (1%), 31 brow raising (37%), 24 brow lowering (7%), 13 mouth gestures (11%), and one other gesture (1%). During these sessions, Deniz mostly utilized headshakes, brow raising, and brow lowering. His nonmanual production differed in mother and sister sessions.

The mother produced 146 nonmanual gestures. Her nonmanual gestures included 24 headshakes (16%), 42 backward head tilts (29%), six sideward head tilts (4%), 56 brow raising (38%), 10 brow lowering (7%), eight mouth gestures (6%). She predominantly used brow-raising and backward head tilts.

The sister produced 64 nonmanual gestures. Her nonmanual gestures included 15 headshakes (23%), 10 backward head tilts (16%), one sideward head tilt (2%), 24 brow raising (38%), five brow lowering (8%), 9 mouth gestures (14%). She primarily used brow-raising, like the mother, but it was followed by headshakes.

A similar pattern was observed in the rate of nonmanual gesture usage as seen in the gesture unit type and manual gesture usage. Deniz exhibited variations in his production of nonmanual gestures depending on his interaction partner. During sessions with his mother, he used nonmanual gestures 81% of the time (87/108) while his mother used nonmanual gestures 73% of the time (146/200). In contrast, when interacting with his sister, he used nonmanual gestures 63% of the time (114/180), while his sister used nonmanual gestures 65% of the time (64/98). In conclusion, a correlation existed between Deniz's nonmanual production rate and his communication partner's rate. It suggests the influence of the interlocutor on his nonmanual production.

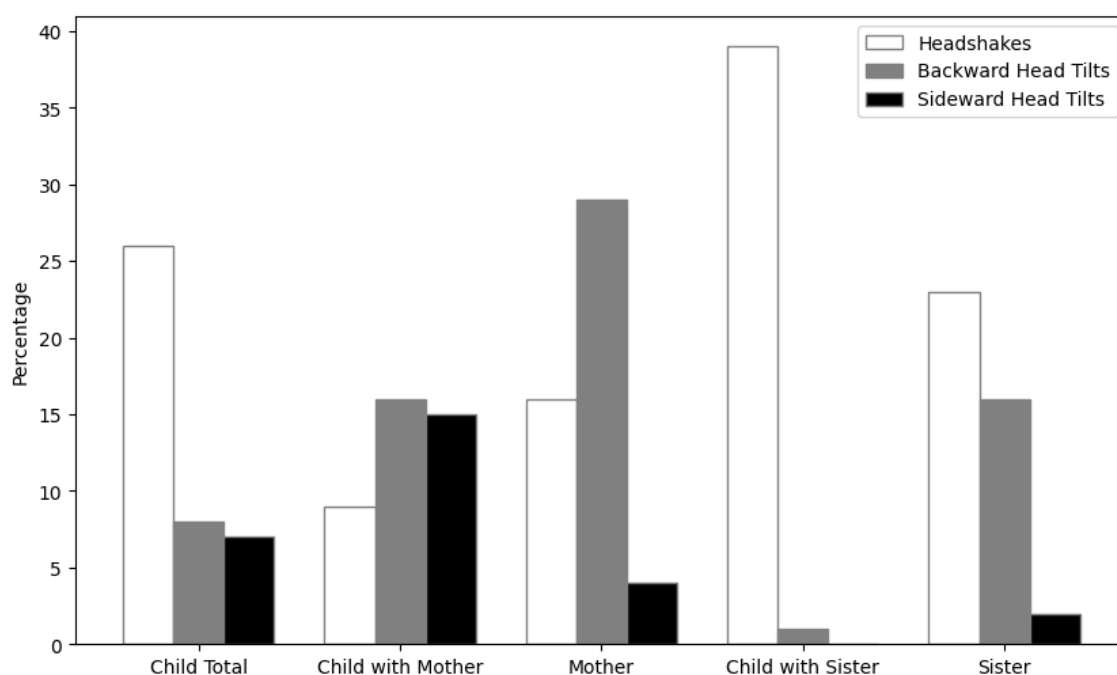


Figure 22. Percentages of headshakes, backward head tilts, and sideward head tilts across family members

In the distribution of nonmanual gesture types, headshakes constituted 9% of Deniz's nonmanual production in sessions with his mother and constituted 39% of Deniz's nonmanual production with his sister (Figure 22). While his mother produced them 16% of the time and his sister 23% of the time. Particularly, 44 out of 52 headshakes (85%) occurred while communicating with his sister.

A similar pattern existed in the rates of backward head tilt. Deniz produced backward head tilts 16% of the time with his mother and 1% of the time with his sister, while his mother produced them 29% of the time and his sister 16% of the time (Figure 22). Particularly, 14 out of 15 backward head tilts occurred while communicating with his mother (93%).

The rate of sideward head tilt was low for all family members (7%, 4%, and 1% for Deniz, his mother, and his sister, respectively). However, Deniz produced all his 13 sideward head tilts in sessions with his mother, who produced six sideward

head tilts (Figure 22). Deniz never produced sideward head tilts with his sister, who produced only one.

In conclusion, Deniz's nonmanual production in sessions with his mother and sister differs from each other and he seems to adapt his manual gestures based on his interlocutor's nonmanual gestures.



CHAPTER 4

DISCUSSION

The current study aimed to discover how Deniz, who did not have access to conventional language input, and his hearing family used gestures to express negation. This research was built upon the study of Franklin et al. (2011), which examined an American homesigner child's ability to negate his sentences and phrases without relying on a language model. However, gestures used by family members around the child were not analyzed to assess whether they constituted a negation model for him. In this respect, this research filled a critical gap by focusing on the effect of input on the emergence of negation in homesign systems.

I delved into this area that remained unaddressed by examining the interactions between Deniz and his hearing family members during six play sessions. This way, I observed different negation forms and their frequencies across family members. I analyzed the negation patterns of family members and how they aligned with each other to understand the dynamics of the homesign system. The study was the first of its kind to investigate the negation expressions of a single deaf child and his hearing family and allowed comparisons between them to comprehend the effect of input. In addition to this, it also provided a cross-homesign comparison with David for the negation structure.

Initially, I aimed to discover whether the deaf homesigner, Deniz, exhibits any negation pattern across several parameters. Following this, I examined his mother's and sister's negation gestures to determine whether they also exhibited any negation patterns. Subsequently, I elaborated my investigations by investigating Deniz's gestures in relation to his interlocutors to make comparisons between family

members. After documenting all negation patterns across reciprocal interactions, I focused on similarities and differences to comprehend the role of input and who affects whom at what level.

4.1 Key findings

The analysis revealed interesting results when Deniz's negation patterns were examined in association with his communication partner. The most remarkable finding was Deniz's gestural adaptability to different inputs. Particularly, Deniz displayed a significant variability in his negation gestures depending on the interaction partner. His flexibility was evident in the variations observed in production rate, distribution of manual and nonmanual gestures, and types of manual and nonmanual forms across the mother and sister sessions. He produced more negation gestures per minute and gesture unit in sessions with his mother than in sessions with his sister.

All family members typically combined manual and nonmanual gestures in gesture units. However, the mother and sister showed proportional differences. The mother favored nonmanual negation gestures more frequently than the sister, who, in contrast, favored manual negation gestures more. Deniz adopted his balance of manual and nonmanual gestures parallel to the negation expression of family members. Specifically, Deniz predominantly produced palm-ups and wrist bendings in sessions with his mother, which closely parallels his mother's production. Deniz produced 75% of his palm-ups and 80% of wrist bendings while interacting with his mother. The distribution shifted dramatically in sessions with the sister, and Deniz utilized most frequently 5-handshape variants and 1-handshape variants as his sister did. Most interestingly, Deniz produced almost all his 5-handshape variants (98% of

all) and 1-handshape variants (94% of all) while interacting with his sister. Additionally, his mother proportionately produced more backward head tilts compared to his sister, and Deniz's backward head tilt production increased. Deniz produced almost all his backward head tilts while interacting with his mother (93%). On the other hand, when his sister proportionately produced more headshakes, Deniz's headshake usage increased. He produced most of his headshakes (85%) while interacting with his sister.

Although Deniz exhibited great optimization skills in various conditions, concatenating gesture units was challenging for him, and he primarily produced single-unit strings. In contrast, his mother and sister presented a more balanced usage of single-unit and multi-unit strings. In their expressions, all family members were mostly prone to locate the negation gesture unit at the end of the gesture string, but their rate of final-string placement differed. His mother and sister placed their negation units at the end of the string in most cases (93% and 83% respectively). Deniz, on the other hand, placed his negations at the string's end 60% of the time. The remaining 40% was at the beginning and this ratio was higher compared to his mother and sister.

4.2 Implications

In a prior study, we evaluated the data of the same child and his family without distinguishing between different family members (Kan et al. 2022). We identified distinct negation patterns for each family member. Each family members presented consistent negation pattern. This suggested that even with consistent linguistic input in homesign systems, a deaf child might not benefit from it. Building on this, the current study tracked the deaf child's negation usage based on his communication

partner. It analyzed his negative expressions and grouped them into sessions with his mother and sister separately. I found that Deniz's negation patterns became clearer when viewed in relation to his interaction partner. His negation expressions were tailored to his communication partner and responded to their predominant strategy. He customized his rate of negation production, the balance of manual and non-manual negation, and specific forms of manual and non-manual negation gestures to match those of his family members. This implied that Deniz could comprehend and track his interlocutor's negations and arrange his productions in response to them. He was sensitive to manual and nonmanual cues coming from his communication partner and could change his gestures. Specifically, Deniz showed sensitivity to not only manual-nonmanual balance but also to different forms of manual and nonmanual negation gestures. He can distinguish different kinds of gestural input and modify his behaviors. Deniz's gestural shift between interlocutors emphasized his capacity to design his negation strategy and his competence within the homesign system.

Deniz displayed a wider range of negation gesture forms than David, who primarily produced side-to-side headshakes (Franklin et al., 2011). This contrast reduces the likelihood of a universal form of negation and reinforces the effect of input on the negation in the homesign system. However, Deniz was 6 years old, and David was 3 during the time of observations. Initially, Deniz may have negated by using headshakes, the universal pattern David presented. However, his negation expressions might have altered with time as he was exposed to familial input. The frequency of Deniz's headshakes offers a chance to make this speculation.

Furthermore, I assessed the sessions to ensure that Deniz simply did not copy what he saw. I examined his negations and his interlocutor's negations that occurred

before his negations. This evaluation revealed that he rarely repeated the negation forms used by his mother and sister (4% of his total negation production). Thus, Deniz's gestures were not direct imitations of his family members. For example, although Deniz adopted his communication partner's strategy, their most used manual forms differed. For instance, wrist bendings constituted 50% of the mother's manual negations, while palm-up constituted 71% of Deniz's when communicating with her. Similarly, 1-handshape variants constituted 56% of the sister's manual negations, but 5-handshapes constituted 59% of Deniz's when communicating with her. Even though their two most used forms were the same in their reciprocal interaction, these findings evidenced that Deniz comprehended and adopted his gestural input but did not simply copy it.

Despite the ability to simultaneously produce gestures into gesture units, Deniz demonstrated limited performance in connecting these units in a linear sequence. Conversely, his mother and his sister displayed more multi-unit strings whereas Deniz produced single-unit strings predominantly. As opposed to studies in which the homesigner outperformed his interlocutors (Goldin-Meadow & Feldman, 1977; Goldin-Meadow & Mylander, 1983; Wang et al., 1993), the mother and the sister presented better concatenation skills than the deaf homesigner in this study. This inconsistency between Deniz and his family members contradicted previous negation patterns found and raised questions about the reason behind his limited capability. What previously helped Deniz adopt structures successfully seemed inadequate to exceed the threshold of the concatenation in negation expressions. His limited ability to form multi-unit strings could be due to several reasons. First, he might have been able to concatenate his gesture units into multi-unit strings but not negation ones. The execution of multi-unit negation strings might require higher

linguistic capability than other structures, such as positive declarative strings or questions. Secondly, the concatenation of different units and sequential organization might be more cognitively demanding. His cognitive development may enable him to grasp what his interlocutor means but may also prevent him from using this structure effectively. Both deaf and hearing children, who are typically exposed to conventional language input from birth, pass to the multi-word stage from the one-word stage between 18-24 months (Fletcher & McWhinney, 1995; Mayberry & Eichen, 1991). The regularity of conventional language input might help to facilitate this transition for these children. However, the homesign system might not provide the same level of structured input. Deniz could produce multi-unit negation strings but relied mostly on single-unit negation strings. Even though he began to build multi-unit structures and went beyond the one-unit stage, he has not reached the multi-unit stage yet, at least for negation. Thus, the cognitive burden of executing multi-unit negation strings may outweigh Deniz's linguistic capacity. Finally, the ability to concatenate might necessitate a larger and more complex linguistic community to evolve. The mother and sister's competency might come from the linguistic system they have already used. They combine different linguistic structures, particularly negation, and arrange them sequentially in Turkish. The input and practice might enable them to transfer this ability from Turkish to homesign and to use longer negation strings. Accordingly, it may not be possible for Deniz because he has limited interactants and gestural systems used only by them.

Additionally, Deniz may have typically responded to his mother's and sister's questions with single-unit answers. To understand this, I examined 108 single-unit strings. Only 8 single-unit responses directly addressed the question. Thus, this

evaluation showed Deniz's restricted ability to integrate the negation gesture units with other units.

In his multi-unit strings, Deniz followed the string-final pattern as his family did. Even though Deniz presented string-initial placements, he predominantly placed his negation at the end, unlike David, who placed %79 his negation headshakes at the beginning of his sentences (Franklin et al., 2011). This discrepancy sparked the debate on the universality of negation in homesign systems because of conflicting findings. However, Deniz produced string-initial placement at a higher rate than his family. One may speculate that he might have had a pattern like the one David displayed at the beginning. His usage changed over time as he was exposed to familial input. This could explain the higher rate of string-final placement and the still relatively high rate of string-initial placement. Additionally, again, the fact that David was 3 years old and Deniz was 6 years old during the assessments provided a basis for this assumption. However, the very limited number of multi-gesture string productions made it difficult to make a robust inference.

Conversely, his mother and sister predominantly followed the string-final pattern. Taking into account that their native language is Turkish and that Turkish is a head-final language (Kornfilt, 1997), it is plausible to suggest that they may have transferred the negation structure of spoken Turkish into the homesign system through their gestures. The family's integration of Turkish negation structures into their communication system, thereby providing linguistic input for Deniz, might explain why Deniz's pattern differed from that of David.

Finally, the homesign system used by Deniz and his family presented a unique blend of features and cannot fit into one homesign category defined above. The system met certain criteria of oralist homesign defined by Reed (2022): Deniz

was not in contact with other deaf people and exclusively communicated with his hearing family, and the system was not transmitted to other generations. In addition to this, the family lived in an urban area, İstanbul. However, the homesign system failed to fulfill several core characteristics of typical oralist homesign. It was not the product of a single deaf person and cannot be characterized by the unsuccessful interaction attempts of a deaf signer. Conversely, this gestural system shared similarities with rural homesign (Reed, 2022). It involved people of different ages and was developed by a deaf child and his hearing interlocutors. Therefore, due to its unique conditions, it potentially lies between oralist homesign and rural homesign which highlighted the diversity of homesign languages as Goico and Horton (2023) suggested. However, the rural homesign category might be structurally closer to it because hearing interlocutors in rural areas are more eager to interact with their gestures and play an active role in shaping reciprocal communication (de Vos & Pfau, 2015; Green, 2022). Similar to the parents of the homesigner boy in Yau's research (1992), Deniz's mother and sister participated in gestural communication with joy, and they built a system with him. This outcome underscored the importance of hearing people's predisposition to deaf people and how reciprocal interaction enriches the linguistic environment.

In conclusion, contrary to previous studies (Goldin-Meadow & Feldman, 1977; Butcher et al., 1991; Goldin-Meadow & Mylander, 1983), which showed that communication partners provided little or no input to homesigners, the current results indicated that hearing interlocutors can serve as models for a homesigner child through their gestures. Despite variations, the hearing interlocutors each provided an internally consistent structure that the deaf child could follow. His ability to adapt to these structures confirmed that they were linguistically consistent and that he could

perceive and distinguish them. However, if the homesigner child has cognitive and linguistic restrictions, as seen in the concatenation, they may not reflect the input. While certain properties of language are fundamental to language and might not require a model to arise, some properties need input to emerge (Goldin-Meadow, 2020; Rissman et al., 2020). In this case, the restricted skill of a deaf child supported the idea that the input may not be sufficient to develop some properties (Kan et al., 2022). Moreover, Deniz and his family's similarities indicated that the system is shared by all members. Despite their different negation patterns, Deniz's mother and sister established an effective communication system with Deniz that they all understood. This is in line with the finding that small communities tolerate variability more compared to larger communities (Raviv, Meyer, & Lev-Ari, 2020). Further, although it was not their primary communication system, family members used negation forms as effectively as Deniz. Turkish family members engaged in communication more actively just like their Chinese and Nicaraguan counterparts did (Goldin-Meadow & Mylander 1998; Flaherty et al. 2021). For that matter, they surpassed the capability of the child and presented a higher ability in concatenation.

As a result, even though it was not conventional, this consistent language input could have formed a stepping-stone of negation emergence for the deaf child. As Senghas et al. (2013) pointed out, this mutual communication between family members might foster and accelerate the development of language properties, like negation.

4.3 Limitations and suggestions

The conclusions of this study must be considered with its constraints. First, as a case study, the focus of this study was on one Turkish child and his family. Even though it

opened a valuable window to the role of input and interaction dynamics, the size of the sample limits generalizations of findings to other homesign environments. More comprehensive homesign studies are required to explore the development of negation across homes in Turkey and to strengthen these findings.

In addition to this, Deniz's age imposed challenges in concluding who introduced the structure into the system and who adopted it. It is observed that a rich environment with fluent reciprocal interactions existed. Nevertheless, understanding the emergence and development of the negation is needed to determine who is responsible for the structure and how it evolves. In this family, anyone could have introduced a negation structure into the system and this structure may have transformed over time. It could have diverged over time or already have been different for everyone from the onset. Alternatively, there might not have been a structure initially, and it could have developed during interaction. However, Deniz's age limited the evaluation of these scenarios. Thus, further research should begin to investigate communication from onset to answer better how deaf and hearing interlocutors play a role in the genesis of homesign. In this way, the negation development of homesigner children can also be compared with those children who develop negation through conventional input.

Moreover, the short intervals between play sessions prevented the evaluation of whether they developed structures over time through interactive dynamics. A more extended longitudinal study would allow researchers to track the evolution of communication structures. This could provide a more comprehensible perspective on how and when these structures are adopted and changed.

The scope of this study covered only forms of negations and built its arguments on them. Investigating different functional types of negation gestures

(rejection, denial, etc.) might provide answers for why negation gestures are used, as Franklin et al. (2011) did. Also, this study left other gesture types, such as those used for questioning, unanalyzed. The analysis of these gestures could provide better insights into homesign structure. This would help to understand whether concatenation restriction is special to negation or not.

Finally, no previous study has focused on co-speech negation gestures of Turkish speakers. It is unknown whether the gestures of Deniz's family were already present in their co-speech gestures and had structure. Therefore, further investigations should address these gestures used by Turkish people for negation when speaking, and how they are used. This would enlighten whether, and at what level, the homesign system interacted with Turkish co-speech gestures.

Despite its limitations, the study robustly illustrated that hearing family members around the homesigner can provide rich linguistic input with their gestures although the input might show variability between these people. The homesigner could benefit from this input and use it as a scaffold for certain language properties. On the contrary, this input may be insufficient to enhance some linguistic abilities for homesigners but hearing interlocutors, with the help of their primary language, can perform better than the homesigner in the system.

In short, the current study provides insights into the dynamics of family interaction in the development of homesign systems and underlines the impact of input on the homesigner's linguistic expressions. Thus, it improves our understanding of homesign communication with a detailed examination of a homesigner child's adaptive strategies in his linguistic environment. This contributes to the broader discussion of language emergence and development and offers a platform for future research.

APPENDIX A

THE CODING TEMPLATE GUIDE

The Coding Template Guide is a guide created to code communication chunks containing negation by using the ELAN program for a homesign system in this study. The Coding Template uses negation forms found in Turkish Sign Language. The parts following the Communication Chunks will be added as a separate line for each family member and coded accordingly.

1. Communication Chunk

A communication chunk is a group of strings created to provide context for which negation gesture(s) are used. The dialogue indicating the context in which the negation occurs is presented here. A communication chunk can consist of one or more strings. The number of communication chunks is written in this section. The communication chunk number starts from 1 for each video and continues incrementally.

2. Gesture String Number:

I isolated gesture strings by using motoric criteria (Goldin-Meadow & Mylander, 1984, p. 18): “A relaxation of the body part(s) used for gesture production or the break (lasting two or more seconds) after a gesture unit or series of gesture units signaled the end of a string.” A gesture string can be either quick and simple communicative motions or continuous and different movements. The strings are numbered starting from 1 in this section. For instance, if there are sentences within Communication Chunk 1, these sentences are numbered 1, 2, and 3.

3. Gesture String Type

The type is indicated here according to the number of gestures contained within the string.

- Single Gesture String: When a string consists of a single gesture, it is labeled as a 'Single Gesture'. If there are multiple gestures produced simultaneously (for example, raising eyebrows and shaking head at the same time), this option is still selected.
- 3.2 Multi-Gesture String: When a string contains multiple gestures produced, it is labeled as 'Multiple Gestures'.

4. Turkish Meaning

The corresponding Turkish meaning for each string is expressed here. If the string can be inferred from the context or is spoken aloud by the person producing it, or if it is explained afterward, it is written in this section. If these options are not available, the best guess is provided or left blank.

5. English Meaning

The corresponding English meaning for each string is expressed here. If the string can be inferred from the context or is spoken aloud by the person producing it, or if it is explained afterward, it is written in this section. If these options are not available, the best guess is provided or left blank.

6. Gesture Unit Number

This section is where the gesture units within the string are numbered and separated.

If the string contains a single unit gesture, only '1' is written in this section. If the

string consists of multiple gesture units, these gesture units are numbered starting from 1.

As in the example provided above, in Communication Chunk 8, string numbered 3 consists of a single gesture unit, so '1' is entered in the Gesture Unit Number section. Strings 1 and 2 consist of multiple gesture units, so the gesture numbers are listed as 1 and 2.

7. Gesture Unit Class

- 7.1 Deictic gestures indicate objects, people, and locations in the immediate environment, and their meanings are context-bound. There are two types of deictic gestures:
 - 7.1.1 Hold-up gestures in which the participant holds up an object in the partner's line of sight.
 - 7.1.2 Pointing gestures in which the participant extends a finger or palm toward an object.
- 7.2 Iconic gestures describe actions or attributes of concrete or abstract referents via hand or body movements (Figure 8c-d).
- 7.3 Conventional gestures include hand and body movements that were conventional in form and that were associated with conventional meanings in Deniz's hearing community.
- 7.4 Negation gestures include manual (Section 8) and nonmanual (Section 9) gestures used to reverse a truth value. In our study, negation gestures convey these meanings in various forms.

8. Manual Negation

Manual negation gestures include negation expressions produced by hands. Manual negation gestures are classified based on their forms:

- 8.1 1-handshape variants: They are produced by extending an index finger, palm facing out, and shaking it back and forth laterally. Only the index finger is extended while the other fingers are curled into a fist, closed, or partially closed. The thumb is opposed and closed so the thumb restrains the middle finger. This handshape has two-handed and one-handed variants.
- 8.2 5-handshape variants: They are produced by extending a hand, palm facing out, and repeating side-to-side movement. This handshape usually involves all fingers extended upright and spread apart. The hand is generally open and relaxed, and the fingers are usually spread wide. This handshape has two-handed and one-handed variants as well.
- 8.3 Palm-up: It involves a hand configuration, where the palm is open and facing upward and all fingers are loosely extended. The gesture involves a lateral separation of the two hands (or a lateral movement of one hand) or it involves a movement toward the interlocutor. This handshape has two-handed and one-handed variants, too.
- 8.4 Wrist-bending: It refers to an outward twist of the wrist joint ending in an open handshape. It consists of full wrist bending bringing the fingers from facing downwards to facing upwards. This handshape has two-handed and one-handed
- 8.5 Other: Manual gestures that do not fall into the four categories defined above are categorized as 'other'. These gestures were infrequent, and their occurrence was relatively low. For instance, Deniz used the palm down

gesture, that is, palm(s) facing downward and moving horizontally through space, either along the lateral axis or diagonally downward, to indicate the absence of the toy.

9. Nonmanual Negation 1

Non-manual negation gestures include facial expressions, and head and body movements. In contrast to manual gestures, which involve the production of only one manual gesture at a time, non-manual gestures can be produced simultaneously.

Given that there are instances where up to three different non-manual gestures are produced concurrently, I incorporated these simultaneous productions into the coding process.

- 9.1 Headshake: It involves moving the head from side to side. I followed the same procedure as in the classification of negative palm-ups and investigated accompanying gestures and context to classify a headshake as a negation.
- 9.2 Backward Head Tilt: It is a subtle movement in which the head tilts backward, typically performed slowly and deliberately.
- 9.3 Sideward Head Tilt: It involves tilting the head to one side laterally. It is usually produced for expressing uncertainty by simultaneously accompanying palm-up and brow-raising.
- 9.4 Brow-raising: It is a rapid upward raising movement of both eyebrows. It is usually used with other nonmanual negation gestures.
- 9.5 Brow-lowering: It involves lowering both eyebrows. It is usually used with other nonmanual negation gestures.

- 9.6 Mouth gesture: It involves lowering the lower lip while expressing uncertainty, accompanied by a sideward head tilt and/or palm-up gesture or movement of both lips along with other co-occurring negation gestures.
- 9.7 Other: Non-manual gestures that do not fall into the six categories defined above are categorized as 'other'. These gestures were also infrequent, and their occurrence was relatively low. For instance, Deniz sometimes shrugged her shoulders simultaneously using a palm-up, brow-raising, and mouth gesture when saying 'I don't know'.

10. Nonmanual Negation – 2

This section is filled if there are multiple simultaneous non-manual negation forms. For example, if a person is shaking their head while also raising their eyebrows, "Nonmanual Negation - 1" can be selected for head shaking, and "Nonmanual Negation - 2" can be selected for raising eyebrows.

11. Nonmanual Negation - 3

This section is filled if there are more than two simultaneous nonmanual negation forms. For example, if a person is moving their head backward while also raising their eyebrows and making a mouth gesture, "Nonmanual Negation - 1" can be selected for head movement, "Nonmanual Negation - 2" can be selected for raising eyebrows, and "Nonmanual Negation - 3" can be selected for the mouth gesture.

12. Gesture Unit Type

- 12.1 Manual-Only: If the negation gesture unit contained a manual negation gesture, it was coded as manual-only. Manual-only gesture units can contain only one manual negation gesture at a time.
- 12.2 Nonmanual-Only: If the negation gesture contained nonmanual negation gesture(s), it was coded as nonmanual-only. Nonmanual-only gesture units may contain two or more nonmanual negation gestures.
- 12.3 Manual-Nonmanual Combination: If the negation gesture unit contained both a manual negation and a nonmanual negation gesture, it was coded as a combination.

13. Negation Position

The position of negation gesture units was coded for multi-unit strings that contain at least one negation and one non-negation gesture. The position was not coded for the single gesture strings containing a negation gesture and the multi-unit strings contained only negation gestures because negation was standalone in these strings.

I categorized the position of negation into three types:

- 13.1 String-initial: If the negation gesture was produced at the beginning of the string, it was coded as string-initial.
- 13.2 Mid-string: If the negation gesture was produced between two non-negation gestures, it was coded as mid-string.
- 13.3 String-final: If the negation gesture is produced at the end of the string, it is coded as string-final.

14. Comment

This section is used to note any uncertainties, questions, or ambiguities regarding the communication chunk, string, units, or individual gestures. Additionally, if a manual or nonmanual negation gesture type marked as "Other" is selected, the specific type of gesture is written in this section.



APPENDIX B

GESTURE UNIT COMBINATIONS

1. Child Gesture Unit Combinations

Deniz has 88 gesture units containing manual negation gestures.

Table B1.1 5-handshape Variants Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
5-handshape variants				6
5-handshape variants	Headshake			6
5-handshape variants	Brow Lowering			5
5-handshape variants	Brow Raising			4
5-handshape variants	Headshake	Brow Lowering		8
5-handshape variants	Headshake	Brow Raising		6
5-handshape variants	Headshake	Mouth Gesture		2
5-handshape variants	Brow Raising	Mouth Gesture		2
5-handshape variants	Brow Lowering	Mouth Gesture		1
Total				40

Table B1.2 Palm-up Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Palm-up				2
Palm-up	Headshake			1
Palm-up	Brow Raising			1
Palm-up	Sideward Head Tilt	Brow Raising		3
Palm-up	Sideward Head Tilt	Brow Lowering		1
Palm-up	Headshake	Brow Raising		1
Palm-up	Backward Head Tilt	Brow Raising		1
Palm-up	Brow Raising	Mouth Gesture		1
Palm-up	Brow Raising	Other		1
Palm-up	Sideward Head Tilt	Brow Raising	Mouth Gesture	6
Palm-up	Backward Head Tilt	Brow Raising	Other	1
Palm-up	Sideward Head Tilt	Brow Raising	Other	1
Palm-up	Brow Raising	Mouth Gesture	Other	1
Total				21

Table B1.3 1-handshape Variants Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
1-handshape variants				3
1-handshape variants	Headshake			3
1-handshape variants	Brow Raising			4
1-handshape variants	Brow Lowering			2
1-handshape variants	Headshake	Brow Lowering		2
1-handshape variants	Headshake	Brow Raising		1
1-handshape variants	Headshake	Mouth Gesture		1
Total				16

Table B1.4 Wrist Bending Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Wrist Bending	Brow Raising			1
Wrist Bending	Backward Head Tilt	Brow Raising		3
Wrist Bending	Backward Head Tilt	Brow Lowering		1
Total				5

Table B1.5 Other Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Other	Brow Raising			3
Other	Brow Raising	Mouth Gesture		2
Other	Backward Head Tilt	Brow Lowering		1
Total				6

Deniz has 38 gesture units containing only nonmanual negation gestures.

Table B1.6 Headshake Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Headshake			7
Headshake	Brow Raising		7
Headshake	Brow Lowering		4
Headshake	Backward Head Tilt	Brow Lowering	1
Headshake	Brow Raising	Mouth Gesture	2
Headshake	Brow Lowering	Mouth Gesture	1
Total			22

Table B1. 7 Backward Head Tilt Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Backward Head Tilt			2
Backward Head Tilt	Brow Raising		4
Backward Head Tilt	Mouth Gesture		1
Backward Head Tilt	Brow Raising	Mouth Gesture	1
Total			8

Table B1.8 Sideward Head Tilt Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Sideward Head Tilt	Brow Raising		1
Sideward Head Tilt	Brow Raising	Mouth Gesture	1
Total			2

Table B1.9 Brow Raising Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Brow Raising			4
Total			4

Table B1.10 Brow Lowering Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Brow Lowering			1
Brow Lowering	Mouth Gesture		1
Total			2

2. Mother Gesture Unit Combinations

The mother has 38 gesture units containing manual negation gestures.

Table B2.1 5-handshape Variants Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
5-handshape variants	Headshake	Brow Lowering		3
5-handshape variants	Headshake	Brow Raising		2
Total				5

Table B2.2 Palm-up Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Palm-up	Headshake			3
Palm-up	Mouth Gesture			1
Palm-up	Backward Head Tilt	Brow Raising		5
Palm-up	Headshake	Brow Raising		4
Palm-up	Sideward Head Tilt	Brow Raising		3
Palm-up	Backward Head Tilt	Headshake		1
Palm-up	Backward Head Tilt	Brow Lowering		1
Palm-up	Backward Head Tilt	Brow Raising	Mouth Gesture	1
Palm-up	Sideward Head Tilt	Brow Lowering	Mouth Gesture	1
Palm-up	Sideward Head Tilt	Brow Raising	Mouth Gesture	1
Total				21

Table B2.3 1-handshape Variants Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
1-handshape variants	Brow Raising			1
1-handshape variants	Headshake	Brow Raising		3
1-handshape variants	Brow Lowering	Mouth Gesture		1
Total				5

Table B2.4 Wrist Bending Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Wrist Bending	Brow Raising			1
Wrist Bending	Backward Head Tilt			1
Wrist Bending	Headshake	Brow Lowering		1
Wrist Bending	Backward Head Tilt	Brow Raising		21
Wrist Bending	Headshake	Brow Raising		1
Wrist Bending	Backward Head Tilt	Brow Lowering		1
Wrist Bending	Backward Head Tilt	Brow Lowering	Mouth Gesture	1
Total				27

Table B2.5 Other Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Other				1
Total				1

The mother has 16 gesture units containing only nonmanual negation gestures.

Table B2.6 Headshake Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Headshake			2
Headshake	Brow Raising		1
Headshake	Brow Lowering		1
Total			4

Table B2.7 Backward Head Tilt Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Backward Head Tilt	Brow Raising		7
Backward Head Tilt	Headshake	Brow Raising	2
Backward Head Tilt	Brow Raising	Mouth Gesture	1
Total			10

Table B2.8 Sideward Head Tilt Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Sideward Head Tilt	Brow Lowering		1
Total			1

Table B2.9 Brow Raising Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Brow Raising	Mouth Gesture		1
Total			1

3. Sister Gesture Unit Combinations

The sister has 34 gesture units containing manual negation gestures.

Table B3.1 5-handshape Variants Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
5-handshape variants				1
5-handshape variants	Headshake			1
5-handshape variants	Mouth Gesture			1
5-handshape variants	Headshake	Brow Raising		1
5-handshape variants	Backward Head Tilt	Brow Lowering		1
Total				5

Table B3.2 Palm-up Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Palm-up	Sideward Head Tilt	Brow Raising		1
Palm-up	Brow Lowering	Mouth Gesture		1
Palm-up	Brow Raising	Mouth Gesture		1
Total				3

Table B3.3 1-handshape Variants Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
1-handshape variants				4
1-handshape variants	Brow Raising			5
1-handshape variants	Headshake	Brow Raising		5
1-handshape variants	Headshake	Brow Lowering		1
1-handshape variants	Headshake	Mouth Gesture		1
1-handshape variants	Brow Lowering	Mouth Gesture		1
1-handshape variants	Backward Head Tilt	Brow Raising		1
1-handshape variants	Backward Head Tilt	Brow Lowering		1
Total				19

Table B3.4 Wrist Bending Combinations

Manual Gesture	1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Wrist Bending	Backward Head Tilt			1
Wrist Bending	Backward Head Tilt	Brow Raising		3
Wrist Bending	Headshake	Brow Raising	Backward Head Tilt	Brow Raising
Wrist Bending	Backward Head Tilt	Headshake	Brow Raising	1
Wrist Bending	Backward Head Tilt	Brow Raising	Mouth Gesture	1
Total				7

The sister has 5 gesture units containing only nonmanual negation gestures.

Table B3.5 Headshake Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Headshake			1
Headshake	Brow Raising		1
Headshake	Brow Raising	Mouth Gesture	1
Headshake	Brow Lowering	Mouth Gesture	1
Total			4

Table B3.6 Backward Head Tilt Combinations

1st Nonmanual Gesture	2nd Nonmanual Gesture	3rd Nonmanual Gesture	Frequency
Backward Head Tilt	Brow Raising		1
Total			1



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