Pragmatic Usage and Event Representation in Nicaraguan Homesign Systems

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Language plays a large role in our lives and influences many mental processes. But does every mental process require language? This dissertation investigates how language experience influences the development of thematic roles and pragmatic knowledge, specifically looking at deaf homesigners who have limited to no exposure to spoken or signed language and innovate their own homesign language systems in order to communicate with the people around them. I address methodological questions such as *Will these novel tasks work with homesigners?* as well as theoretical questions such as *Is language required to develop concepts of agents and patients?* and *Can pragmatic knowledge exist without exposure to typical discourse?*

I used novel tasks (i.e., referential communication pragmatics tasks and an eye tracking paradigm) in order to investigate homesigners' pragmatic knowledge and event representation. I found that homesigners will often use pragmatic knowledge and produce necessary relevant information (e.g., modifiers with nouns, or agents and patients with actions). Regarding event representation, homesigners did not appear to use systematic conventionalized strategies (e.g., word order, use of space) to distinguish between agents and patients, although I did observe some preliminary strategies. I also did not find evidence that homesigners used nonlinguistic agent-patient concepts on the eye tracking task. The findings of this dissertation suggest that basic pragmatic knowledge may not require full access to language, but concepts of agent and patient may require more language to fully develop than previously expected. In the absence of early language exposure, lifelong communicative experience may help homesigners to develop pragmatic skills, which then might guide later linguistic structure formation.

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Chapter 1. Introduction

Language is a large part of our lives and influences many of our mental processes. But is language a requirement for everything? This dissertation focuses on how language potentially influences pragmatic knowledge, a critical communicative skill, and event representation, which remains unclear as to whether it relies on language-based or nonlinguistic concepts. In order to better tease apart the influence of language on these two areas, I focus on homesigners who have limited to no access to language. By investigating how homesigners use pragmatics (e.g., knowing and providing what information their conversation partner needs to fully understand) and represent events (e.g., clearly distinguishing who did what to whom when describing an event), we can better understand how these skills interact with (and without) language. Throughout this dissertation, I aim to address methodological questions such as *Will these novel tasks work with homesigners?* as well as theoretical questions such as *Is language required to develop concepts of agents and patients?* and *Can pragmatic knowledge exist without exposure to typical discourse?*

Homesigners and History of Nicaraguan Sign Language

Homesigners are deaf individuals who do not have sufficient access to acquire either a spoken language (because they are deaf) or a signed language (because they are not around other deaf signers) and create their own unique systems in order to communicate with their (mostly hearing) family and friends (Coppola & Newport, 2005; Goldin-Meadow, 2003; Frishberg, 1987). Homesign systems more closely resemble sign languages than gestures produced by non-signers (Brentari et al., 2012; Horton et al., 2015). Even with minimal to no outside linguistic input, homesigners create complex systems, exhibiting morphophonology using selected finger complexity (Brentari et al., 2017), morphosyntax using patterned handshape (Coppola &

Brentari, 2014), grammatical subjects (Coppola & Newport, 2005), negation and question formation (Franklin et al., 2011), and number inflection (Abner et al., 2022).

An important distinction between homesigners and sign language users is the primary language used by the linguistic community. In Nicaragua, deaf signers form a community with the primary language used being Lengua de Señas Nicaragüense (Nicaraguan Sign Language, LSN). A relatively new language, LSN, was created when educational and vocational centers serving deaf children in Managua expanded in the late 1970s, bringing together previously isolated deaf homesigners and allowing them to build a linguistic community, and over time, a new language (Senghas, Senghas & Pyers, 2005; Coppola, 2020; Polich, 2005; Kegl & Iwata, 1989). Although there are around 25 general special education schools and about 5 private programs in Nicaragua that serve deaf children, it is estimated that only about 5% of deaf children in Nicaragua attend school (Coppola, 2020). Because these schools and programs are difficult to access, particularly for those living in rural areas, and/or people may just not know it as an option, the majority of deaf individuals in Nicaragua are homesigners. Since hereditary causes of deafness are very rare in Nicaragua–common causes of deafness include accidents and illnesses– usually the homesigner is the only deaf person in their family (Coppola, 2020). Thus, conversely to LSN signers' experiences, in most homesign situations, the deaf homesigner is often the single primary user of the homesign system, whereas all of the rest of the hearing people around them are using spoken Spanish, which would be the primary language of that community. Even though communication partners use the homesigner's system to communicate with them, they do not use the system in the same way the homesigner uses it (Coppola et al., 2013), so it may not become conventionalized as a consistent system in the same way that LSN became conventionalized when it first emerged. Individual homesign family groups have the

potential to conventionalize, but if they do, it is much slower than LSN because of how centralized a homesign system is, likely because all interactions involve the homesigner (Richie, Yang & Coppola, 2014).

Finally, it is also important to note that while we use the term "homesign," this communication extends beyond the home and many homesigners have rich communication networks (Coppola, forthcoming; Quam et al., 2022; Reed, 2022). Homesigners have friends, relationships, and jobs and can end up interacting with a variety of people outside of their immediate family. While these interactions are typically limited to those with hearing Nicaraguans–who are generally comfortable using their hands to communicate–occasionally, homesigners do meet other deaf individuals. For the purposes of this study, a homesigner's network may include another deaf person, but critically, they do not use LSN with each other (Coppola, 2002).

Importance of Language Input and Early Access to Language

Language is a conceptual resource and influences attention and memory (e.g., Langland-Hassan et al., 2021; Lupyan & Bergen, 2014) and early access to language– sometimes referred to as a sensitive period for language acquisition– is critical for typical development. Even as early as at 6 months old, infants can already use language to gain knowledge, form categories, and understand concepts (LaTourette & Waxman, 2020). Language evidently plays a large role in cognition, and while some theorize that language is modular (e.g., Fodor, 1985), the task of separating language from cognition is quite a difficult one. In most typical cases, people have experienced early and regular language exposure and their brains developed in an environment in which language input was plentiful and accessible. Generally, infants are exposed to language

starting from birth at the latest and have instant access to language, which can exert influence on developmental processes quite early on.

Unfortunately, this is not a common case for deaf individuals. Most deaf and hard-of-hearing children are born to hearing parents, meaning that most deaf children are not exposed to a sign language starting from birth, delaying or reducing their access to a first language (Mitchell & Karchmer, 2004). This can put them at risk for language deprivation, which can have pervasive and persistent negative effects on cognitive and neurological development (Hall, 2017). Timing of first accessible exposure to language (i.e., a sign language, either from birth or some time later) has been found to be associated with a variety of cognitive abilities including working memory (Bebko & McKinnon, 1990; Marshall et al., 2015), executive functioning (Hall et al., 2017; Goodwin et al., 2022), theory of mind (Schick et al., 2007), number knowledge (Walker, Carrigan & Coppola, 2024; Shusterman et al., 2022), analogical reasoning (Henner et al., 2016), and nonverbal reasoning (Quam & Coppola, 2023; Phillips et al., 2014; Meinzen-Derr et al., 2010).

Homesigners are able to create complex systems to communicate with those around them with limited to no outside language input; however, their language experience likely influences some aspects of their linguistic and nonlinguistic abilities. While homesigners can individually innovate aspects of linguistic structure such as morphophonology (Brentari et al., 2017), morphosyntax (Coppola & Brentari, 2014), a noun-verb distinction (Abner et al., 2019), spatial devices (Coppola & So, 2006), and recursive compounds (Wood, 2013), there is not yet evidence that homesigners create conventionalized lexicons (Richie, Yang & Coppola, 2014; Quam, Brentari & Coppola, 2022), count sequences (Spaepen et al., 2011), or ways to communicate false belief (but they do exhibit perspective taking abilities; Gagne & Coppola, 2017) without a

linguistic community. Homesigners' minimal experience with outside language input can allow us to disentangle the influence of language on certain aspects of cognition, but we must remember that no way of languaging is bad (for a nuanced discussion on Crip Linguistics see Henner and Robinson, 2023). It is important to see homesigners as people and validate their language and communication systems, while also recognizing the harm of language deprivation and advocating for early access to sign language for deaf children (Coppola, forthcoming).

Pragmatics

How do we know how much information to provide when conversing with someone? How can we tell when our conversation partner is comprehending us? Pragmatics, that is, understanding the relationship between meaning and context during a communicative interaction, is an important part of language development. It involves linguistic knowledge like semantics, as well as more abstract cognitive abilities like theory of mind (i.e., understanding that another person's mental state and knowledge can be different from your mental state and knowledge) and the ability to understand social contexts. Unlike other foundational linguistic skills such as syntax and lexical knowledge, pragmatic development is quite protracted (e.g., Cekaite, 2013). Being aware of what your conversation partner knows and what information you need to provide is an important part of successful communication.

Very little research has looked at pragmatic understanding in asymmetrical circumstances (i.e., homesign contexts), but doing so could help us to better understand the nature of pragmatic knowledge. Safar and de Vos (2022) found homesigners in Bali used other-initiated repair (a method for mending communication breakdowns in which the person who did not produce the source of the confusion prompts the repair) in conversations with their hearing communication partners. Repair initiated by communication partners has not yet been studied. However, hearing

communication partners' comprehension of homesign utterances, especially out of context, is generally weak (Carrigan & Coppola, 2017). Homesigners are in a unique situation because none of their communication partners fully use their homesign language system as their primary language and homesigners do not have access to typical discourse models. Therefore, their experience and how they use pragmatics may look different. Further discussion of pragmatics continues in Chapter 3.

Thematic Roles and Event Representation

To what extent does language influence the development of agent/patient concepts? Is it possible to represent events and explain who did what to whom without language? A great deal of research has studied humans' representations of agents (i.e., who or what causes an action) and patients (i.e., who or what undergoes the effect or changes due to the action) in multiple languages, using eye tracking studies (e.g., Wilson et al., 2011; Cohn & Paczynski, 2013), reaction time studies (e.g., Hafri, Trueswell & Strickland, 2018), and habituation and preferential looking studies with infants (e.g., Woodward, 1998; Golinkoff & Kerr, 1978; Gordon, 2003; Wagner & Lakusta, 2009). Fillmore (1968) proposed several different thematic roles each with distinct properties assigned to each role, and Dowty (1991) presented the existence of thematic proto-roles in which players involved in events can be represented broadly by entities that cause change (proto-agents) and entities that undergo change (proto-patients). However, none of these studies have been able to fully tease apart language from event representation and thematic roles so it is unclear what these concepts actually look like.

One current debate in the literature is the extent to which language influences the development of the agent/patient concepts. One possibility is that there may be some sort of universal core concept of agent and patient that exists independent of language (e.g., Strickland,

2017; Rissman & Majid, 2019). Evidence from adults being able to quickly discriminate between agents and patients (Hafri, Papafragou & Trueswell, 2013) and infants being sensitive to causal relationships and switching agent/patient roles (Leslie & Keeble, 1987; Golinkoff, 1975; Golinkoff & Kerr, 1978; Saxe, Tenenbaum & Carey, 2005) suggests that these concepts may exist outside of language. However, typically developing infants still have exposure to language starting from birth, so the underlying role of language remains ambiguous. Another theoretical possibility is that language creates syntactic and semantic categories, and that children develop the concepts of agent and patient as they acquire language. The influence of language on cognitive development is quite established in a variety of areas including theory of mind (e.g., de Villiers & de Villiers, 2014), labeling and category creation (e.g., Fulkerson & Waxman, 2007; LaTourrette & Waxman, 2020), and relational and analogical concepts (e.g., Doumas, Hummel & Sandhofer, 2008; Gentner & Christie, 2010). It is possible that the concept of thematic roles may also be influenced by the language acquisition process. Indeed, in a nonlinguistic eye tracking study, Shukla and de Villiers (2021) found that typical adults demonstrated evidence for nonlinguistic concepts of agent and patient by showing an anticipatory effect for reversible two-argument transitive events, but those who had their language access limited in some way (i.e., infants who had not fully acquired language and adults performing verbal shadowing to prevent them from using language on the task) did not. This suggests that language, to some extent, may be necessary to fully conceptualize and use agents and patients. Although these two theories are not necessarily mutually exclusive, and likely exist somewhere on a spectrum, it is still important to understand the relationship between language and the development of these concepts. Further discussion of event representation and agent/patient concepts continues in Chapter 4.

The Current Studies

Many studies have investigated the relationship between language and thematic role concepts (e.g., Rissman & Majid, 2019; Strickland, 2017; Fillmore, 1968; Dowty, 1991), but it is still unclear the extent to which language influences the development of these abstract concepts. Homesigners, who have minimal outside language input, represent one way to disentangle the impact of language. While a few studies of homesigners' representations of agents and patients have been conducted (e.g., Flaherty, 2014; Coppola, 2002; Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005), argument dropping is common amongst this elicitation data, making it difficult to assess the relative treatment of agents and patients. The current study seeks to use a task that puts pragmatic pressure on homesigners to encourage them to produce as much information (agent, patient, action) as possible. Through this study, I aim to better understand the influence of language on agent/patient concepts and either support the theory that agents and patients are universal underlying concepts or provide evidence that language may be necessary for the development of these concepts, in both the linguistic and nonlinguistic domains. Additionally, given the nature of the elicitation tasks, I seek to investigate pragmatic knowledge in homesigners to better understand how pragmatics might work in atypical discourse circumstances (e.g., when one person does not have full access to language and the other person does not fully understand their system).

Novelty and Contributions

With nine homesigners participating, this study has one of the largest samples of adult homesigners in the literature (most others have around four homesigners). Using this new

elicitation task will ideally put more pragmatic pressure on homesigners to produce more arguments in an utterance and reduce argument dropping to allow for more robust analysis. Finally, there have been no published studies investigating nonlinguistic concepts of agent and patient with homesigners nor published studies that have used eye tracking as a methodology with homesigners. The aim of this study is to better our understanding of pragmatic usage in homesign systems and the relationship between language and thematic role concepts; however, we also aim to see homesigners as people and validate their language and communication systems while also advocating for early access to sign language for deaf children.

Research Questions and Hypotheses

Study 1a. *Do homesigners use pragmatic understanding and produce all relevant information (modifiers with nouns) when necessary?*

Homesigners do show pragmatic understanding and engage in other-initiated repair (Safar & de Vos, 2022), so I hypothesize that this new elicitation methodology will encourage homesigners to produce more relevant information. Specifically with regard to nouns and modifiers, researchers have found that homesigners do produce modifiers for nouns, but infrequently (Do et al., under review; Hunsicker & Goldin-Meadow, 2012; Flaherty, Hunsicker, & Goldin-Meadow, 2021). However, none of these studies has used stimuli with contrastive nouns or stimuli that would require modifiers in order for homesigners to be understood and methodology that would put that pragmatic pressure on them. Therefore, this new elicitation methodology seems like a promising way to encourage homesigners to produce more modifiers with their nouns. I predict that homesigners will produce modifiers more frequently when pragmatic pressure encourages them to do so.

Study 1b. *Do homesigners use pragmatic understanding and produce all relevant information (agents and patients with actions) when necessary?*

Similarly, regarding agents, patients and actions, studies have found that homesigners produce agents and patients (e.g., Flaherty, 2014; Coppola, 2002; Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005), however, they are inconsistent. Since this new methodology uses multiple contrastive vignettes, putting pragmatic pressure on participants to produce all three elements (agent, patient, action), ideally homesigners should produce the necessary information. I predict that homesigners will argument-drop less frequently on this task as compared to previous studies.

Study 2a. *Do homesigners linguistically represent agents and patients, and if so, what strategies do they use to distinguish them?*

Linguistically, word order and spatial strategies are viable ways homesigners could distinguish agents and patients. Homesigners have demonstrated argument ordering tendencies (e.g., Flaherty, 2014; Coppola, 2002; Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005), however, due to the prevalence of argument dropping it is difficult to determine the relative treatment of agents and patients in a single utterance. The current study's methodology ideally will minimize argument dropping and allow us to better identify the relative treatment of agents and patients in homesigners' word orders. While I will also look at spatial strategies, they are usually not fully conventionalized in homesign systems (e.g., Coppola & So, 2006; Flaherty, 2014) and take time to develop even once a community of signers forms (Senghas & Coppola, 2001; Kocab, Pyers & Senghas, 2015). If the development of thematic role concepts depends on language, then we will not see evidence of homesigners distinguishing agents and patients, but if

agents and patients are universal underlying concepts, then we should see this reflected in homesigners.

Study 2b. *Do homesigners have nonlinguistic representations of agent and patient?*

Nonlinguistic concepts of agent and patient may be harder to get at, but I will try to replicate an eye tracking paradigm done with both typical adults and infants (Shukla & de Villiers, 2021). In this study, typical adults showed an anticipatory effect when viewing reversible two-argument transitive events, meaning that they picked up on the pattern by engaging their concepts of agent and patient. Alternatively, adults engaging in verbal shadowing and 1- to 2-year-old infants did not show this anticipatory effect (but did on one-argument intransitive events), suggesting that language may be involved in agent and patient concepts. If my results align with Shukla and de Villiers's (2021) findings, we would see that homesigners would not show an anticipatory effect. However, if they do, perhaps that means that they do have and use these nonlinguistic concepts.

Roadmap

The organization of this dissertation is as follows. Chapter 1 introduces the topics and research questions. Chapter 2 describes the general approach and methodology for all of the studies. Chapter 3 focuses on pragmatics and presents two studies that leverage pragmatic pressure to encourage homesigners to produce enough or more relevant information (modifiers with nouns in Study 1a; agents and patients with actions in Study 1b). Chapter 4 focuses on event representation and investigates homesigners' agent/patient concepts, both linguistic (Study 2a) and nonlinguistic (Study 2b). Chapter 5 offers a synthesis and discusses the findings and implications.

Chapter 2. Methodology

General Fieldwork and Data Collection

The data for this dissertation was collected during two field trips, each about 2 weeks long, during March 2023 and January 2024. Our team consisted of a mix of deaf and hearing American Sign Language (ASL) and Nicaraguan Sign Language (LSN) signers, some of whom knew English and/or Spanish. We mostly worked in Managua, Estelí and Jinotega, Nicaragua. Most participants came to our temporary lab spaces, but in some cases, we traveled to participants' homes. During the first field trip in March 2023, with the assistance of local contacts (deaf and hearing), we recruited 6 new homesigners. We also invited back 3 homesigners who had participated in previous studies with members of the research team. Eight homesigners (6 new, 2 returning) participated in the studies we ran in March and eight homesigners (5 new (recruited in 2023), 3 returning) participated in January.

Participants

We recruited 9 adult homesigners for the current study. Their mean age is 45 years old (range 25 to 65 years); 4 are female and 6 are male (Table 1). Three of the homesigners have participated in previous studies, and six are brand new to the study. Criteria for inclusion in the study were: a lack of accessible language in the home during childhood; limited or no formal education using signs, use of signs to communicate, and limited or no opportunities to learn LSN. Note that at least two of the new participants have had extended access to LSN, over a period of decades, but have not acquired it, likely due to their exposure to LSN beginning after the end of the sensitive period for language acquisition. All of the homesigners we recruited lived in western, Spanish-speaking areas of Nicaragua.

Table 1. Participant demographic information.

	N	mean age (range)	gender N (%)	hearing status
Homesigners	9 6 new 3 returning	45 yrs (25-65)	4 female (44%) 6 male (66%)	9 deaf
Communication Partners	11	43 yrs (23-63)	6 female (55%) 5 male (45%)	8 hearing 3 deaf

We also recruited 11 people who were regular communication partners of the homesigners (mean age: 43 years old; range: 23–63 years old; 6 female, 5 male). Communication partners of homesigners included three brothers, three sisters, one husband, two mothers, one niece, and one friend. Note that there are more communication partners than homesigners because some of the homesigners worked with a different communication partner for the second visit. In fact, only two communication partners remained consistent from the March 2023 trip to the January 2024 trip. Additionally, two of the homesigners are friends, who live in different towns, so they do not have regular interactions. They acted as communication partners for each other during the study (i.e., one homesigner did the task in the producer role and the other in the comprehender role, then they switched roles and completed the task again with a different stimulus list).

Eight of the communication partners are hearing and three are deaf. A few homesigners have some interactions with deaf signers; however, members of the research team fluent in LSN watched their signing (in person and video recordings afterwards), and determined that these homesigners were not using LSN grammar, and thus they were still classified as homesigners. One homesigner's husband is an LSN Cohort 1 signer (i.e., he was among the group of deaf

individuals who first started creating LSN when educational and vocational centers serving deaf children in Managua expanded in the late 1970s[1]). While the homesigner has been exposed to LSN from her husband, she does not use LSN grammar like her husband does; therefore, we have classified her as a homesigner. Because this homesigner does have some exposure to LSN, it is possible that her homesign system may look different than other homesigners who have had less interaction with other deaf people, especially those who know LSN, so we will keep that in mind during the analysis. Another homesigner has a Deaf signing friend and is learning some lexicalized LSN signs, but again is not using LSN grammar. Another homesigner has a younger sister who is also deaf, who attended the Hogar Escuela in Ciudad Darío, a private boarding school for deaf children that (at that time) focused on teaching the children to speak and understand Spanish, and which did not use LSN. The younger sister learned some Spanish at the school, and began learning LSN in her twenties; however, the older sister (who was in her forties at this time) did not learn LSN from her and still does not appear to use LSN structures or grammar, therefore, we have also categorized her as a homesigner. Again it is possible that this homesigner's system may look quantitatively different from other homesigners' due to this potential influence. We plan to conduct separate analyses of these participants with some LSN exposure to determine whether their patterns are similar to those observed in the other homesigners.

A brief description of each participant follows. This information is based on interviews with the participants and their family members, and for homesigners who had participated previously, earlier documentation from similar interviews. For all participants, the cause of

[1] For more about the history and creation of Lengua de Señas Nicaragüense (LSN), see Senghas, Senghas & Pyers (2005), Polich (2005), Kegl & Iwata (1989), and Coppola (2020).

deafness was unknown, unless otherwise stated. Each homesigner has been given an ID number (based on when they were first recruited).[2]

Homesigner 02

Homesigner 02 is a man who was 42 years old at the time of our last visit. He lives with his family in a town about a 6 hour drive north of Managua. He is the only deaf person in his family. He attended a small local school at age 12 for one year (with no special education services) and a school for deaf children from age 16 to 18 (2 months per year) taught by two Deaf LSN signers from Managua. He knows some common lexical items. His mother and younger brother (who acted as his CPs in this study), as well as his younger sister, communicate with him using gestures. He has limited contact with a few other deaf people in the area (e.g., he reports having a deaf friend who paints nails) but none of them knows LSN. He has been a participant in many research projects for several decades (since he was 13 years old). See Coppola (2002) (referred to there as Homesigner 2 and "Pedro") and Gagne (2015) (referred to there as NAHS02) for more details.

Homesigner 03

Homesigner 03 is a man who was 47 years old at the time of our last visit. He lives with his hearing family in Managua. He had a few deaf friends as a child, but none of them knew LSN or any other conventional sign language. He attended a privately run vocational center for people with various disabilities when he was 18 for 6 months, but was not taught any signs. His mother

[2] The homesigners' ID numbers reflect their original participant codes in order to be consistent with previous studies that include the same homesigners (e.g., Homesigner 02 in the current study is referred to as Homesigner 2 by Coppola, 2002 and NAHS02 by Gagne, 2015).

gestures with him a lot, as does his older brother (who acted as his CP). He has been a participant in many research projects for several decades, since he was 18 years old. See Coppola (2002) (referred to there as Homesigner 3 and "Gerónimo") and Gagne (2015) (referred to there as NAHS03) for more details. We reconnected with him during our March 2023 trip and intended to include him as a participant then, however, he had just had an accident and was unable to participate. When we returned 9 months later (in January 2024), he had made a full recovery and was able to participate.

Homesigner 05

Homesigner 05 is a woman who was 46 years old at the time of our last visit. She lives with her hearing family in Estelí, about a 3 hour drive north from Managua. She never received any formal schooling or education. Her younger sister who frequently gestures with her acted as her CP. Around late 2017 to early 2018, she met some Jehovah's Witnesses and attended weekly classes for 3 months where she learned very few lexicalized LSN signs. She does not have any contact with other deaf people or signers. She has been a participant in several previous research projects. See Gagne (2015) for more details (referred to there as NAHS05).

Homesigner 17

Homesigner 17 is a man who was 44 years old at the time of our last visit. He lives with his hearing family in Jinotega, a city about a 2 hour drive east of Estelí. He was born in a town about an hour drive north of where he currently lives. His deafness was likely due to meningitis when he was 11 months old, although his family did not realize he was deaf until age 2. He briefly attended a hearing school (for a few weeks) at age 10 and a deaf program with 10 other students (for a brief but unknown amount of time). He works in his family's corner store with his

sister who gestures with him frequently. He was recruited by one of our local contacts, Marwell Zelaya, a Deaf teacher at a special education school in the area. He is friends with Homesigner 18 but they do not see each other frequently since they live in different towns (about a 3 hour bus ride). Between our first and second visits, he became friends with an LSN signer who lives in town. This signer has been teaching him some LSN vocabulary (e.g., he learned signs for colors). Homesigner 17, in turn, taught some of the new signs he learned to Homesigner 18 when they saw each other for filming in January 2024.

Homesigner 18

Homesigner 18 is a man who was 32 years old at the time of our last visit. He lives in a small town about a 2 hour drive northeast from Estelí. His deafness was likely due to his mother getting dengue fever during pregnancy. He does not have any deaf family members and has limited to no contact with his hearing family members. He never attended formal school and currently works in construction. He has one deaf friend who lives in the same town but it is unclear if this friend knows a conventional sign language (though we suspect this is not the case since Homesigner 18 does not know many LSN signs). He was recruited by Homesigner 17, who he is friends with, but only sees occasionally since they live about a 3 hour bus ride away from each other. He has been trying to learn a few LSN signs from Homesigner 17.

Homesigner 19

Homesigner 19 is a woman who was 25 years old at the time of our last visit. She lives with her hearing family in a very rural area in the mountains about an hour and half drive northeast from Estelí. She went to a hearing school from ages 5 to 10 and had a hearing teacher who learned a few signs. She currently works on a tobacco farm. She befriended a deaf woman

who also works on the tobacco farm but says that she signs very differently; again we suspect that this new friend is not an LSN signers because Homesigner 19 still does not seem to know many LSN signs. In January 2024 she had recently started dating a deaf man who had attended a deaf school and potentially knew LSN, but at the time, she did not seem to have picked up any LSN signs from him. Her younger sister and mother gesture with her and acted as CPs. She was referred to participate in the study by a local hearing contact.

Homesigner 20

Homesigner 20 is a woman who was 63 years old at the time of our last visit. She lives with her younger sister (13 year age difference) who is also deaf in Jinotega. She works as a seamstress out of her home. She never had any formal schooling; however, her younger sister (from age 6 to third grade) attended the Hogar Escuela in Ciudad Darío, a private boarding school for deaf children that (at that time) focused exclusively on teaching the children to speak and understand Spanish, and did not use a sign language. At age 28 (when Homesigner 20 was 41 years old), her sister started learning LSN from a hearing interpreter, attending classes twice a week for about 2 years. Homesigner 20 knows a few lexicalized signs in LSN, but her signing does not look like her sister's signing. Their late father was hard-of-hearing and their late brother was deaf, but neither of them knew any LSN. Given the number of deaf/hard-of-hearing family members, there is likely a genetic component to her cause of deafness. In addition to her deaf sister, her hearing niece (the daughter of the deaf sister who knows LSN) acted as a CP. She was recruited by one of our local contacts, Marwell, a Deaf teacher at a special education school in the area.

Homesigner 21

Homesigner 21 is a man who was 45 years old at the time of our last visit. He lives about an hour drive northeast of Estelí where he works on a farm that is quite remote. He has been working on farms and in the fields since he was 15 years old. He attended a deaf program for three months when he was 20 years old, but other than that has had no formal schooling. He has a deaf sister, but does not see her. He does not interact with very many people outside of work. His hearing younger brother, who uses some gestures and who he sees infrequently, acted as his CP. He was referred to participate by a local hearing contact.

Homesigner 22

Homesigner 22 is a woman who was 65 years old at the time of our last visit. She lives in Managua with her deaf husband and hearing sons. She was born in Estelí but moved to Managua as a child. Her hearing mother was stung by a scorpion while pregnant with her and became very sick; she was also very sick when she was born and became deaf around 4 months of age. She spent three months in school at age 10, but left because she had no deaf friends. When she was 25 years old, she learned to sew and currently works as a seamstress. She is married to a deaf man who was among the group of deaf individuals who first started creating LSN when educational and vocational centers serving deaf children in Managua expanded in the late 1970s. Her husband is actually one of the oldest Cohort 1 signers. Although they met in their late twenties and have been married for about 40 years, and she has LSN exposure through her husband, Homesigner 22 does not use LSN grammar in the same way that he does. Therefore, we still classified her as a homesigner since she picked up some LSN vocabulary but very little grammar from her exposure to LSN. She was recruited by members of el Equipo Sordo, the Deaf

Team in Nicaragua, who are a group of deaf LSN signers in Managua collaborating with researchers in the United States to study their own language, Danilo Morales and Mayela Rivas.

Recruitment and Data Collection

In total over both field trips, we recruited 6 new homesigners and reconnected with 3 homesigners who had participated in previous studies. Recruitment and data collection for homesigners in Nicaragua is different from traditional psychological studies. As researchers from the United States, it is incredibly important for us to establish trust and a rapport with our participants, particularly those who were new and were unfamiliar with us. This typically included first meeting the participant to assess if they fit the criteria for our study and explaining who we were and what we were doing in Nicaragua. If they were interested in participating and fit inclusion criteria, we would plan to meet another day to run all of the tasks. Data collection for one new participant typically lasted a good portion of a full day. We started every session with videoed informed consent in which one of the researchers (fluent in LSN and experienced with homesign language systems) would review the entire process. Written consent forms in Spanish were available to hearing communication partners, and researchers who spoke Spanish could explain or clarify things for them too. Afterwards, we conducted informal background interviews with new participants to learn who they were and gain a better understanding of their experiences with language and education, and of their homesign language system. Returning participants were not extensively interviewed, but we did have informal catch-up conversations. Part of the data collection day also included sharing a meal with participants and their family members. It was important for participants to feel comfortable with us and for us as researchers to make it clear that we value their time and greatly appreciate them allowing us to learn from them.

Stimuli and Tasks

With the exception of one returning homesigner who only participated in January 2024, all participants completed the Event Pragmatics tasks and the first run of the Noun-Modifier Pragmatics tasks in March 2023. All of the eye tracking data and another run of the Noun-Modifier Pragmatics task were collected during the January 2024 trip. I now briefly describe the three tasks.

Noun-Modifier Pragmatics Task

Before diving into studying agent and patient production, first we need to address pragmatic understanding in homesigners and see if certain task demands can encourage homesigners to produce enough relevant information. Research with emerging sign languages finds that production of size and shape specifiers (one kind of modifier) varies and is often semantically and signer driven (Safar & Petatillo Chan, 2020). A recent study with Nicaraguan and Guatemalan homesigners found that they produced modifiers for nouns but very infrequently (Do, Kirby, Horton, Abner, Flaherty, Coppola, Senghas & Goldin-Meadow, under review). Similar to previous research with agent-patient production in homesigners, there is evidence that homesigners produce noun modifiers, but not consistently. Therefore, the stimuli in the Noun-Modifier Pragmatics Task was specifically designed to encourage participants to produce modifiers along with nouns.

This novel elicitation task (described in detail in Chapter 3) used a referential communication paradigm and contrastive stimuli to leverage participants' pragmatic knowledge. Homesigners were shown cards containing four images and asked to describe the target item to their communication partner, who would then select which of the four items the homesigner had described. In order for communication partners to choose the correct item, on trials with a similar

distractor item (half of the trials) homesigners would ideally need to use modifiers to distinguish between the correct target and the distractor. This task was run twice: once in March 2023 with 7 participants, and again in January 2024 with 8 participants (this time instructing CPs to limit their input before guessing an item). Two participants who did the task in January 2024 had not done the task 9 months earlier, however, one was familiar with the task since he had acted as another homesigner's CP (comprehender role) during the March 2023 run and the other participant was familiar with similar tasks since he had participated in similar previous studies.

Event Pragmatics Task

As laid out in previous sections, the number of arguments produced in an utterance ranges across tasks, from frequent argument dropping (Flaherty, 2014) to more consistent productions including tasks reported in Coppola (2002) and further analysis of some of those data that were reported in Coppola and Newport (2005) and in Carrigan and Coppola (2017). Homesigners' consistency in producing both agents and patients in the same clause seems to partially depend on the type of elicitation task and analysis. The Event Pragmatics Task used a similar paradigm to the Noun-Modifier Pragmatics Task in order to encourage homesigners to produce agents, patients, and actions in their initial utterance.

Homesigners were instructed to describe the target video presented amongst three other videos, each describing a simple transitive reversible event with two characters. Communication partners then had to select the video they thought the homesigner was describing. On every trial, the target video was accompanied by three distractor videos including (a) a different action, (b) a different agent or patient, and (c) the agent and patient in swapped roles. Therefore, in order for communication partners to be able to select the correct video, homesigners needed to produce all three elements (agent, patient, action).

Nonlinguistic Agent-Patient Eye Tracking Task

This task aimed to assess nonlinguistic concepts of agent and patient by using stimuli designed by Shukla and de Villiers (2021). In this task, participants passively watched a series of animations depicting dogs pushing cars and cars pushing dogs. They were instructed not to sign or respond during the task in order to minimize language use. Participants watched one of two versions in which target animation was always the same agent/patient combination. If participants picked up on the pattern (i.e., the video with the same agent/patient combination always becomes colorful and plays again), we would expect them to direct their gaze toward the target video in anticipation of it to play again. Their eye gaze movements were recorded during the anticipatory period, 2.5 seconds between when a + appeared and when the target video turned colorful and played again.

Coding and Analyses

I used criteria laid out in Coppola (2002) and related work with LSN signers (Kocab & Snedeker, in prep) to determine utterance boundaries. Each homesigner's responses were coded using ELAN (Wittenburg et al., 2006), a video annotation program that allows coding of simultaneous aspects of gesture and sign. I coded 82% of the data and trained two research assistants (one hearing, one deaf, both fluent signers of ASL who have experience with LSN and homesigns) to code 30% of the videos as well, with some overlap across all coders to check for reliability.

Because of the very small sample size and the nature of the studies, for many of the analyses I used non-parametric tests and comparisons to chance performance. Much of the

results also rely on descriptive and qualitative linguistic analysis. When appropriate (which was not often), I also used different quantitative analyses (e.g., parametric tests).

Study 1a (Noun-Modifier Pragmatics Task)

Here, I coded homesigner's productions (initial and subsequent) for nouns (labels) and modifiers (e.g., adjective, classifier, sign modification). I also coded communication partners' initial responses to calculate a percent correct score. I used logistic mixed effect models to investigate whether the presence of a distractor item predicted if homesigners would produce modifiers. I also assessed communication partners' comprehension by comparing their rate of correct responses to the level of performance expected by chance.

Study 1b (Event Pragmatics Task, part 1)

This coding and analysis was similar to the Noun-Modifier Pragmatics Task. For each trial, I coded homesigners' initial productions of signs referring to the agent, patient, and action. I also coded communication partner's initial responses to calculate a percent correct score. I present descriptive information about how often each of the three elements (agent, patient, action) are present in an initial utterance. I also assessed communication partners' comprehension by comparing their rate of correct responses to the level of performance expected by chance.

Study 2a (Event Pragmatics Task, part 2)

Here, I continued my analysis of data from the Event Pragmatics Task, focusing on strategies to disambiguate agents and patients. I specifically looked at homesigners' word order preference (e.g., agent-patient-action vs. patient-agent-action) and use of spatial strategies, but I

also report uses of other devices (paired verbs and patient poses). I also investigated whether use of these strategies affected communication partners' comprehension.

Study 2b (Nonlinguistic Agent-Patient Eye Tracking Task)

I followed the analysis plan used by Shukla and de Villiers (2021) to code and analyze my data. Eye gaze was coded just over the x-axis (i.e., which side of the screen (left vs. right) did participants look at for the most time during the anticipatory period?). I calculated the proportion of time participants spent looking in each direction during the 2.5 second anticipatory period on each trial. Then, I calculated the mean duration of gaze direction when the target was on the left and when the target was on the right for each participant. I used a linear mixed effects regression to assess whether participants anticipatorily looked to the right when the target was on the right (and vice versa for the left). I also calculated, for each participant, the proportion of trials that they looked to the target side, regardless of which side of the screen it was on. If participants showed an anticipatory effect, their mean gaze direction would match the location of the target video. If participants did not tend to look at the side of the target video during the anticipatory period (waiting for the target video to play again), they would not show the anticipatory effect.

Chapter 3. Pragmatics

Background

Understanding the interplay between meaning and context during a communicative interaction, also known as pragmatics, is a critical skill in language development. It involves not only linguistic knowledge like semantics, but also theory of mind (i.e., understanding that another person's mental state and knowledge can be different from your mental state and knowledge) and the ability to understand social contexts. Knowing what your interlocutor knows and what information you need to provide is important for successful communicative interactions. Unlike other foundational linguistic skills such as syntax, pragmatic understanding takes children a long time to develop (e.g., Cekaite, 2013). Additionally, because there are so many aspects of pragmatic understanding, it becomes difficult to tease apart specific elements. For example, pragmatics abilities are highly correlated with both grammar and vocabulary, but within the label of pragmatic abilities, many of these skills are only somewhat correlated with each other, suggesting that different pragmatic skills may rely on different cognitive skills, and that general language ability and pragmatic understanding likely scaffold each other (Wilson & Bishop, 2022). A great deal of research has looked at pragmatics focusing on development in children, competency in second language learners, and difficulties in individuals with developmental or learning disabilities. However, very little research has looked at pragmatic usage in folks who do not have access to an established language. In order to narrow the scope of this section, I will focus on pragmatics research in three contexts: deaf and hard-of-hearing individuals, cross-linguistic signing situations, and homesign systems.

Pragmatics for Deaf and Hard-of-Hearing Children

Many studies claim that deaf and hard-of-hearing children have weak pragmatic skills (e.g., Szarkowski, Young, Matthews & Meinzen-Derr, 2020; Goberis et al., 2012; Duncan & O'Neill, 2022). However, some (but not all) of these studies do not consider that a majority of deaf and hard-of-hearing children are born to hearing parents, meaning that most deaf children are not exposed to a sign language starting from birth, delaying or reducing their access to a first language (Mitchell & Karchmer, 2004). This can put them at risk for language deprivation, which can have pervasive and persistent negative effects on cognitive and neurological development (Hall, 2017). Deaf children who do have immediate language access from birth (e.g., exposed to a sign language through their deaf signing parent) show typical development of skills comparable to hearing children in areas such as language acquisition (Lillo-Martin & Henner, 2020; Newport & Meier, 1985), executive functioning (Goodwin et al., 2022; Hall et al., 2017), theory of mind (Schick et al., 2007), and working memory (Marshall et al., 2015). This overwhelming evidence suggests that it is not deafness that is the issue, but rather a problem of language access. Indeed, children who have delayed exposure to their first language and limited instances for communicative interactions may struggle with pragmatics due to their language experience, not their hearing status.

Pragmatics in Cross-Linguistic Situations

What does pragmatic usage look like when the two conversation partners do not fully share a linguistic system? Byun and colleagues (2018) looked at strategies in dyads of deaf signers using different signed languages, focusing on other-initiated repair and try-markers. Other-initiated repair occurs when the comprehender indicates they did not understand the producer by either asking a question (restricted requests or restricted offers) (e.g., "who?" or "did

you mean…?"), making a confused remark (open class) (e.g., "what?" or "huh?"), or making non-manual signals (e.g., raised or furrowed eyebrows, wrinkling nose, blinking). Subtle non-manual backchanneling can also include holding or freezing the hands with a blank facial expression (Manrique & Enfield, 2015). Try-markers can be used to signal (often with eye contact and holding the final sign, occasionally with mouthing and/or repetition) when the producer is not sure whether the comprehender will be familiar with a specific sign, but they try using it anyway and are prepared to troubleshoot if the comprehender did not understand the sign. Byun and colleagues (2018) found that signers from South Korea, Uzbekistan, Netherlands, and Hong Kong who had never met and did not share a common sign language were able to use the iconic affordances of their visual manual language to repair communication breakdowns and improve understanding. Signers used both fast track repair sequences (e.g., Signer B indicates not understanding and Signer A produces a repair before Signer B has finished signing because Signer A has anticipated a need for repair) and delayed response repair sequences (e.g., Signer A does not anticipate the need for repair so when Signer B indicates confusion, Signer A must take time to think of how to repair), in order to converse about a variety of complex topics (e.g., personal life, experience with academia).

Pragmatics in Homesigning Situations

We know that successful communication is possible in cross-signing situations, but what about in homesign contexts? Homesigners are in a unique situation because in most cases their homesign language system is not fully shared by others so their communicative interactions may be very asymmetrical. Homesigners have neither a language model nor typical conversational experience since most of their communication occurs with (hearing) family members who are not primary users of the homesign system. This might mean more communication breakdowns

and needs for repair. This communication experience, which might be a little more effortful and a little less clear, could also influence linguistic patterns over time. For example, Quam, Brentari and Coppola (2022) found that adult homesigners were more likely to produce multiple signs for a single response and use multiple handshape forms to describe a single item, compared to child and adolescent homesigners who typically produced a single sign and use a single handshape form. This difference between adult and child homesigners could be partially explained by adult homesigners' extensive experience of trying to communicate and not being understood, which could lead them to preemptively produce more information from the beginning to try to avoid possible communication breakdowns. Additionally, adults may have more cognitive ability to come up with alternative expressions in order to be better understood. Adult Nicaraguan homesigners' handshapes are less consistent on subsequent responses compared to initial responses (Goldin-Meadow et al., 2015), perhaps partially due to the need to modify handshapes in order to improve comprehension. Adult Nicaraguan homesigners also produced multiple handshapes for a single item much more often than child and adolescent homesigners (Quam, Brentari & Coppola, 2022). Homesigners' linguistic productions may be influenced by both their lack of access to typical conversational discourse and their experience of having communication partners not fully comprehend their productions.

Safar and de Vos (2022) found that homesigners in Bali used other-initiated repair (i.e., when the communication partner indicates that they do not understand, so the homesigner repairs accordingly) in conversations with their hearing communication partners. There were more instances of restricted requests and offers, but implicit and explicit open requests were also used. This mirrors repair patterns in established signed languages, although, overall frequency of other-initiated repair was generally more with homesigners. However, repair initiated by

homesigners has yet to be studied. Hearing communication partners' comprehension of homesign utterances, especially out of context, is relatively weak. Carrigan and Coppola (2017) found that homesigners' hearing mothers were significantly worse at comprehending homesign descriptions of vignettes produced by their deaf adult children than Spanish descriptions from their hearing adult children. In fact, Deaf native ASL signers, who had never interacted with the homesigners and were not familiar with their homesign systems, but did have lifelong experience communicating in the visual-manual modality, were significantly better at comprehending homesigners' descriptions than the homesigners' mothers (3 out of 4 Deaf ASL signers outperformed homesigners' mothers in comprehension assessments). It seems that experience using a sign language including producing and receiving linguistic information visually may aid in comprehension more than familiarity with the homesigner and their linguistic system.

Modifier Production in Homesign Systems

With regard to nouns and modifiers, researchers have found that homesigners produce modifiers for nouns, but infrequently (Do et al., under review; Hunsicker & Goldin-Meadow, 2012; Flaherty, Hunsicker, & Goldin-Meadow, 2021). In an elicitation study with 4 Nicaraguan adult homesigners and 8 Guatemalan child homesigners, Do and colleagues (under review) found a total of 20 modifiers produced across all homesigners (19 trials per participant). All 4 adult homesigners produced at least one modifier, but only 3 child homesigners ever produced a modifier. This is striking when compared to the 22 LSN signers who produced a total of 519 noun-modifier utterances (on average 23.5 modifiers per participant). However, the stimuli used to elicit these productions (i.e., vignettes of atypical events such as a hammer being dropped into a trash can) did not necessarily require modifiers in their description. Participants were not instructed to describe the items in the vignettes or focus on any physical characteristics of the

items. It is possible that the use of modifiers in this study felt extraneous or optional to some participants; why would you need to specify that the hammer fell into the *black* trash can if there is only one trash can in the vignette? Because these stimuli (originally from Abner et. al, 2019) did not require modifiers to be produced in order to complete the task, this could explain why this study found such few modifiers in homesigner productions. Other methods of modifier-specific elicitation could include showing participants contrastive nouns or events, encouraging them to use modifiers to differentiate the two similar items, and/or turning it into a referential communication task in which participants produce descriptions for a communication partner who then must select the correct picture or video based on the description. Referential communication tasks have been successful at eliciting modifiers in ASL signers (Rubio-Fernandez et al., 2022). Leveraging homesigners' pragmatic understanding could improve the rate of modifier production that previous studies have found.

Argument Dropping in Homesign Elicitation Tasks

Similar to the issue discussed in the previous section about low rates of modifiers produced by homesigners, earlier research on the treatment of arguments in homesign systems suggests that homesigners do produce agents and patients, but not consistently (e.g., Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005; Flaherty, 2014; Coppola, 2002). Again, this is likely partially due to the elicitation materials that may not reliably elicit productions containing all elements of interest (agent, patient, action) in the same clause. Goldin-Meadow and Mylander (1998) reported that both American and Taiwanese homesigning children were more likely to produce patients than agents in a naturalistic play setting.

There is also a methodological issue of some researchers identifying grammatical subjects and objects instead of thematic roles since these categories are not exactly the same. For

example, grammatical subjects can be either agents or patients (e.g., *The kid [subject and agent] petted the dog* versus *The dog [subject and patient] got petted*). Coppola and Newport (2005) found that adult homesigners typically placed Subjects at the beginning of clauses, however, both agents and non-agents (e.g., patients) could be classified as Subjects. Therefore, it is difficult for us to contrast the relative treatment of agents and patients in homesigners' productions with this information.

Flaherty's (2014) dissertation analyzed 1175 utterances from the same homesigners and only 16% (190) of these utterances included two noun arguments that could be identified as a subject and an object (i.e., both agent and patient included). Coppola's (2002) dissertation revealed that homesigners produced agents with actions on 65-79% of utterances, but did not identify how many utterances also contained a patient with the agent and event. Also the nature of the research question addressed meant that only a small subset of items contained both a human agent and patient.

Because argument dropping, which occurs in many spoken and signed languages, is also common in homesign systems, elicitation tasks must be designed to promote production of all of the elements of interest in a single clause. There must be task demands to produce both agents and patients in a single clause, or a homesigner may not be inclined to produce both arguments every time. Again, homesigners' pragmatic understanding would need to be leveraged to reduce argument dropping during elicitation tasks.

Study 1a: Pragmatic Pressure to Produce Modifiers with Nouns

Do homesigners use pragmatic understanding and produce modifiers with nouns (all relevant information) when necessary?

Before analyzing event representations, I analyzed performance on a similar, but slightly less difficult task involving nouns and modifiers. One of the goals of this task was to see if this referential communication task would put pragmatic pressure on homesigners to produce more information. Since homesigners have been shown to produce modifiers sparingly (Do et al., under review), we hoped that the design of this task, which included contrastive items that often would require modifiers for the communication partner to select the correct item, would lead to more modifiers being produced. Since homesigners have been shown to use pragmatic knowledge (Safar & de Vos, 2022), we hoped that homesigners would be sensitive to the pragmatic pressure in our task, encouraging them to produce more modifiers.

Participants

Seven homesigners participated in the first run (in March 2023). Six communication partners and one homesigner acted as comprehenders (in total, 3 deaf and 4 hearing). Eight homesigners participated in the second run (in January 2024). This time in the comprehender role, we had six communication partners, one homesigner, and one experimenter. Six (of the nine) homesigners did the task both times. See Chapter 2 for more details about the participants.

Procedure

The Noun-Modifier Pragmatic Task was often one of the first tasks run with participants. Homesigners were instructed to describe the target item (presented amongst three other images) and communication partners had to select the item they thought the homesigner was describing. However, on half of the trials, one of the additional items was similar to the target item, which should require homesigners to provide more information (e.g., modifiers). We ran the task with most participants twice: in the first run we allowed some back and forth between the homesigner

and the communication partner, while in the second (strict) run we tried to limit communication partner input until after they had selected their guess in order to prompt homesigners to provide more information in their initial production. Because the instructions were different, I analyzed the sets of runs separately first, and then when results were the same, combined them into one analysis.

The setup for the task was as follows. The homesigner sat in a chair next to one researcher who held the stimulus cards. Several feet away, facing the pair, the communication partner sat next to another researcher who had a set of stimulus cards. Each stimulus card showed colored line drawings of four everyday objects (Figure 1; see Appendix A for full stimuli list). On the homesigner's set of stimulus cards, one object was marked with a sticker as the target item which they were directed to describe to the communication partner (using signs), who then picked which of the four objects the homesigner was describing. Once the communication partner selected an object, their choice was shown to the homesigner to get confirmation if that was the object they were describing. If the initial choice was wrong, the homesigner was directed to describe the object again and the communication partner would again select an object based on the homesigner's description. Two video cameras were set up to record the homesigner's productions as well as the communication partner's responses.

Task Orientation

Before the task began, the homesigner was shown both sets of the first stimulus card to make it clear that the communication partner was looking at the same exact items, just without the sticker denoting the target item on the communication partner's set. Additionally, at the start of the first trial with a distractor item, the experimenter would point out to the homesigner that there were two similar items and directed them to describe the target item only.

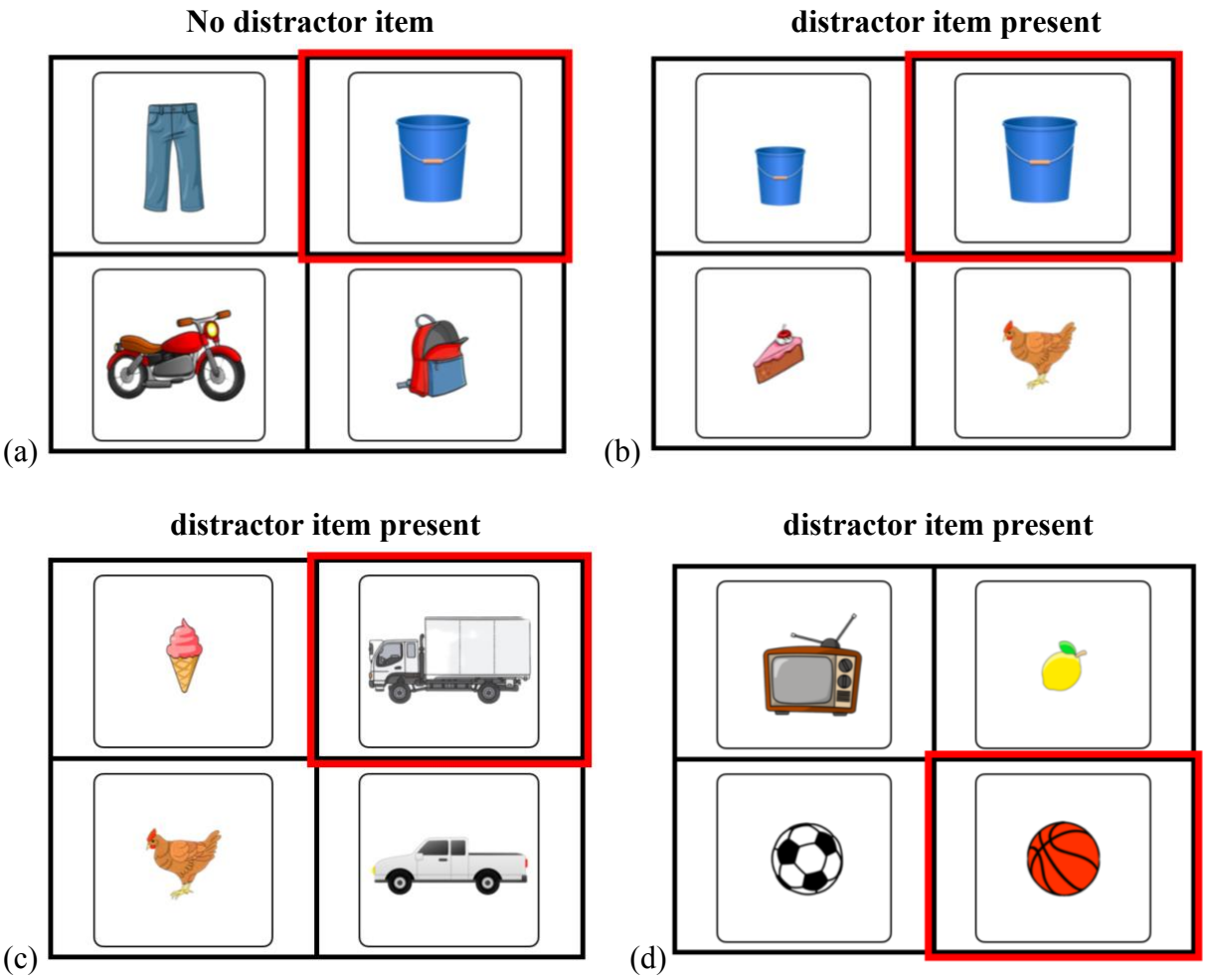


Figure 1. Examples of stimuli for the Noun-Modifier Pragmatics Task. The first stimulus card (a) shows a trial with no distractor, while the rest are examples of trials with a distractor item: (b) large bucket vs. small bucket, (c) semi truck vs. pickup truck, and (d) basketball vs. soccer ball.

The stimuli included 32 trials, 16 of which were fairly straightforward, containing line drawings of four unrelated objects (trials without a distractor) and 16 that had a distractor item alongside the target object plus two additional distinct objects. On trials with a distractor, one of the non-target objects was very similar to the target object (e.g., large bucket vs. small bucket, semi truck vs. pickup truck). These distractor items were intended to put pragmatic pressure on homesigners to provide noun modifier information so that their communication partner would be able to distinguish the nouns and pick the correct object. Because there were two similar objects,

this type of elicitation task should encourage homesigners to produce modifiers. There were two versions of the task, which were counterbalanced based on which item was the target item versus distractor for item on the trials with a distractor (e.g., in version 1 the target item was the basketball, whereas in version 2, the target item was the soccer ball).

We ran this task with most homesigners twice (7 participants in March 2023 and 8 participants in January 2024). The second time we ran the task, we attempted to exert more control by asking the communication partners to choose a picture before asking for more information or clarification. By reducing the back-and-forth conversation between communication partners and homesigners, we aimed to encourage homesigners to produce more modifiers on their initial productions.

Coding and Analyses

For all trials, I coded the homesigners' productions, specifically noting nouns and the presence or absence of a modifier (e.g., adjective, classifier, sign modification). Signs were coded as nouns if they represented the item or could be considered a label for the item (e.g., DOG, TREE, BALL, SHIRT). Note that homesigners do not always have consistent lexicons and may not have lexicalized nouns in their vocabularies, but for simplicity's sake, here, I will refer to the labels they created for items as nouns. Signs were coded as modifiers if they described the item (e.g., BIG, SMALL, ORANGE, LONG-SLEEVES). Most initial utterances included a noun (since labeling the item was necessary), but subsequent utterances sometimes only included modifiers (to distinguish two items after the label had been given). Interrater reliability for coding nouns and modifiers was 95%.

I also denoted whether the utterance was an initial production or a subsequent production depending on when the communication partner responded (either making a guess, requesting

more information, or clarifying) since the communication partners' input could influence the homesigners' subsequent productions on that trial.

From there, I calculated on what proportion of trials with a distractor homesigners produced nouns and modifiers. I also compared that to how often homesigners produced nouns and modifiers on trials without a distractor, which do not put the same pragmatic pressure to produce modifiers, to see if the type of elicitation paradigm in the test trials does indeed lead to homesigners producing more modifiers in order to disambiguate similar objects.

Finally, for every trial, I coded whether the communication partner's initial response was correct (because at most there was one similar item, so by process of elimination, most of the time, communication partners were able to guess the correct item the second time). For every pair of homesigners and communication partners, I then calculated a percent correct score.

The main analyses for this study were (i) testing if modifiers were produced significantly more often on trials with a distractor, and (ii) testing if the percent correct (communication partner's initial answer) was above the level of performance expected by chance (50%).

Results

Homesigners' Productions

First, I analyzed homesigners' productions of modifiers on trials with a distractor (when modifiers would be necessary to disambiguate items) and without a distractor (when modifiers would not be necessary). All of the following productions were initial utterances unless stated otherwise. A logistic mixed effects model with trial type (with or without distractor) as a fixed effect and participant ID and stimulus item as random effects and controlling for Run Order (first or second) found that trial type significantly predicted modifier usage ($t = 4.405$, $p < 0.001$)

(Table 2). On trials with a distractor item, homesigners were 2.12 times more likely to produce modifiers.

Comparing this model to the null model (i.e., Modifier_Pres ~ 1 + (1 | ID:Item:Run), family = binomial) using ANOVA revealed a significant difference between models indicating that inclusion of the trial type (with or without a distractor item) significantly contributed to the model ($X^2(3) = 47.67$, $p < 0.001$) and improved model fit. There was also a significant difference between the current model and one that nested Run Order as a random effect ($X^2(2) = 27.41$, $p < 0.001$), but the current model was a better fit.

Table 2. Results from logistic mixed effects model <- glmer(Modifier_Pres ~ Trial_Type + Run + (1|ID) + (1|Item), family = binomial)

	Includes Modifier (yes) β (SE)
Trial Type (w/ distractor)	**0.915 (0.208)****
Run (Second)	0.069 (0.221)
Intercept	-0.374 (0.337)
Observations	475
Note:	**p<0.05; **p<0.01; ***p<0.001*

Random Effects	Variance	SD
Participant ID	0.434	0.658
Item	0.465	0.682
Groups: Items 16; ID 9		
AIC: 606.2; BIC: 627.0; $R^2 = .25$		

I also ran logistic regressions for each run (first and second) separately (see Appendix B for regression tables) and found that in all cases, the presence of a distractor on the trial did predict more modifier usage (Figure 2). On the first run, 5 (out of 7) homesigners produced modifiers in an utterance on more than 50% of trials with a distractor, that is, when they were necessary, (M = 57%, SD = 27%), whereas only 3 homesigners produced modifiers on more than 50% of trials without a distractor (not necessary) (M = 44%, SD = 24%). On the second run, 7

(out of 8) homesigners produced modifiers in an utterance on more than 50% of trials with a distractor (M = 68%, SD = 16%), whereas only 1 homesigner produced modifiers on more than 50% of trials without a distractor (M = 44%, SD = 10%).

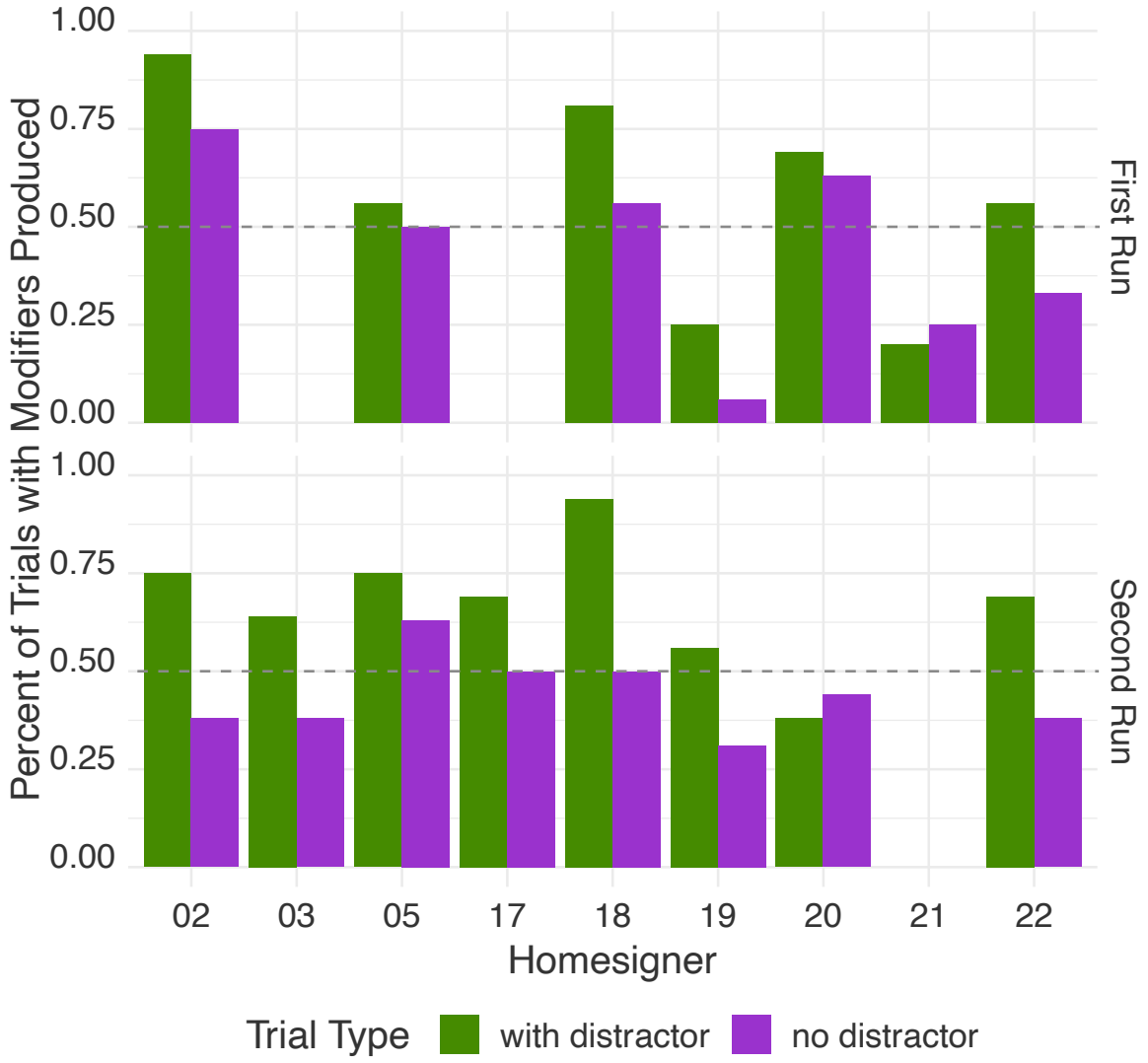


Figure 2. Modifier production in first (top) and second (bottom) runs. Overall, most homesigners (5 of 7 in first run; 7 of 8 in second run) produced modifiers on at least 50% of trials with a distractor (green bars). Gray dotted line denotes 50% of trials. Blank spaces indicate that the homesigner did not participate in that run.

Subsequent Productions

I next analyzed subsequent productions, that is, anything the homesigner produced after the communication partner responded by either selecting an incorrect response, requesting more information (e.g., indicating confusion, encouraging the homesigner to tell them more), or clarifying specific points (e.g., asking if the target was big or small).

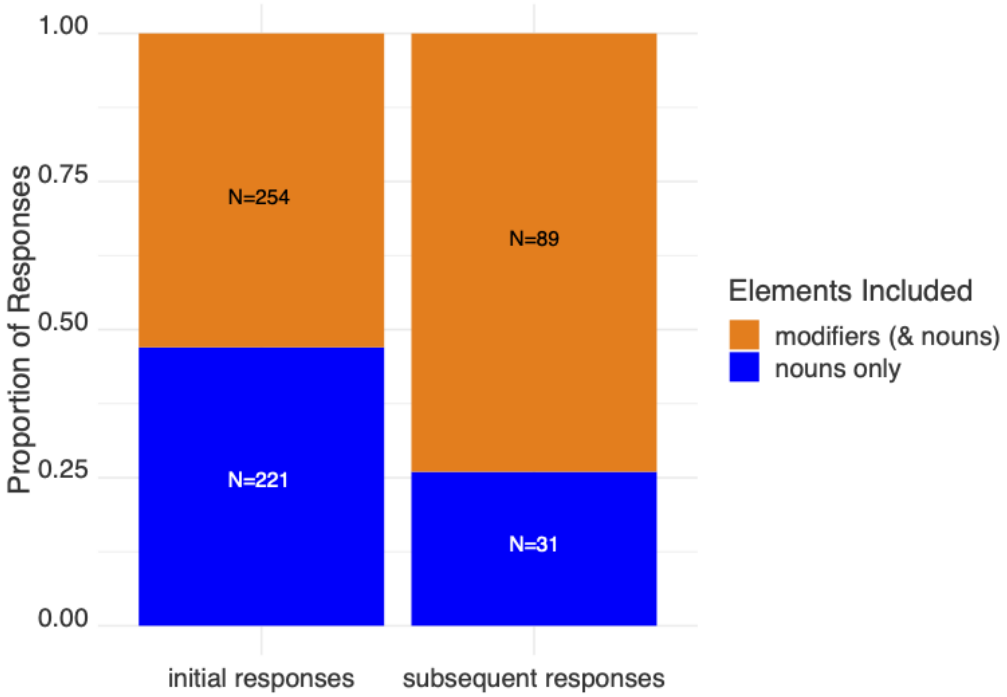


Figure 3. Overall, homesigners produced a higher proportion of modifiers on subsequent utterances compared to initial utterances.

As a majority (96%) of trials without a distractor were answered correctly on the initial response, most of the subsequent productions were on trials with a distractor. I compared utterances with modifiers (and nouns) to utterances with nouns only in initial vs. subsequent utterances. A chi-squared test showed a significant difference between utterances with modifiers and nouns compared to utterances with only nouns on initial versus subsequent productions ($X^2(1, N = 595) = 16.801$, $p < 0.001$). Homesigners tended to produce more modifiers on

subsequent utterances (74% of subsequent utterances contained a modifier) than initial utterances (53%) (Figure 3). Separate analyses of the first run versus the second run found the same results. Modifiers were more likely than nouns alone to be produced in subsequent utterances, while there was little difference between overall noun and modifier production in initial utterances.

Communication Partners' Comprehension

Overall, trials with a distractor item were more difficult than trials without. The initial correct response rate was 68% (N=135) for trials with a distractor and 96% (N=219) on trials without a distractor. Generally, CPs were responding correctly at a rate above the level of performance expected by chance (50%) with an average initial correct of 68% (SD = 14%, range 41%–84%) on the first run and 80% mean correct (SD = 10%, range 66%–91%) on the second run. CP comprehension was higher on the second run compared to the first. Six participants (three of whom did the task with the same CP) did the task both times and therefore their improved performance on the second run may reflect practice effects.

Hearing status also influenced CP performance. Deaf CPs had marginally higher rates of correct responses (first run: mean = 71%, SD = 9%; second run: mean = 86%, SD = 7%) compared to hearing CPs (first run: mean = 65%, SD = 18%; second run: mean = 76%, SD = 10%). However, Wilcoxon rank-sum tests indicated that the difference between hearing and deaf CPs was not significant in either the first run or the second. Additionally, the one CP who performed at chance level was hearing.

I also examined which information the homesigner had produced on trials that the CP got incorrect. I looked at the first and second runs separately since the rate of incorrect responses was so much lower in the second run. Starting with the first run, in 56% of instances (n=18), the homesigner did not produce any modifiers, and in most of these cases there was a distractor item

so a modifier would be necessary to select the correct item. Additionally, in 28% of instances (n=9) (also all trials with a distractor item), the homesigner produced modifiers but they were either unclear (e.g., signing both BIG and SMALL without indicating which is the target) or not contrastive (e.g., describing the shape of sunglasses but not in a way that distinguishes them from the regular eyeglasses). Conversely, in 9% of instances (n=3), the homesigner did seem to produce enough information, but the CP did not appear to understand.

On the second run, in 40% of incorrect instances (n=16), the homesigner did not produce any modifiers, and in all of these cases there was a distractor item so a modifier would be necessary to select the correct item. In 15% of instances (n=6) (also all trials with a distractor item), the homesigner produced modifiers but they were either unclear or not contrastive. Conversely, in 30% of instances (n=12), the homesigner did seem to produce enough information, but the CP did not appear to understand. In these cases, half of the trials had distractor items and half did not; here, the communication breakdown was likely related to lack of conventionalized lexicon or the CP not comprehending certain signs (e.g., signing NOT-SMALL LARGE BOOK and the CP choosing the small book; signing VASE and the CP choosing the lamp).

Finally, in order to check for practice or learning effects on the first run (i.e., when the task was completely new to all participants), I compared performance on the first half (trials 1-16) and second half (trials 17-32) and found that three CPs gave more correct responses in the second half, one CP gave more correct responses in the first half, and three showed no significant difference. For the participants who improved on later trials, it is unclear whether homesigners' productions became more clear or CPs got better at comprehension (or both). Therefore I compared homesigners' production of modifiers on the first half and the second half. Fisher's

exact tests reveal that two homesigners, 05 ($p<0.01$) and 21 ($p<0.05$), showed practice effects, producing significantly more modifiers on the second block of trials. Homesigner 18 produced marginally more modifiers on the second block ($p=0.053$). The other four homesigners did not show any significant differences in modifier production from one block to another. Interestingly enough, only one participant (Homesigner 18) had more modifiers produced in the second half and a CP whose correct response rate was higher in the second half.

Summary and Discussion

Overall, homesigners did produce modifiers more often when necessary (on trials with a distractor item). A logistic mixed effects model found that homesigners were 2.5 times more likely to produce modifiers on trials with a distractor (when modifiers would be necessary) than on trials without a distractor (modifiers not necessary). Modifiers were also proportionally more likely to be produced than nouns alone on subsequent utterances compared to initial utterances. This suggests that homesigners are sensitive to feedback from CPs (e.g., answering incorrectly or requesting more information or clarification) and modulate their subsequent responses accordingly. All together, these findings support the claim that homesigners do use pragmatic knowledge.

The second run found very similar results to the first run. The rate of CPs' correct responses was higher (80% mean correct vs. 68% mean correct), but this could have been a result of practice effects. Since six homesigners completed both runs of the task, even almost a year later, they may have been more comfortable with the type of task the second time around. Only three participants had the same CP on both runs, but in all three cases, CP comprehension was better on the second run. However, on the second run, on a higher proportion of incorrect responses, homesigners did appear to produce enough information (i.e., modifiers on a trial with

a distractor) but the CP still did not understand, which seems to partially contradict evidence of practice effects.

Table 3. Comparison of results between the first run (from March 2023) and second (stricter) run (from January 2024, in which CPs instructed not to ask for more information). On the second run, the rate of CPs' correct responses was much higher and homesigners produced a higher rate of modifiers for trials with a distractor item.

	First Run (March 2023)	**Second Run** (January 2024)
Participants	7 Homesigners (2 experienced, 5 new) CPs: 3 deaf, 4 hearing	8 Homesigners (6 participated in first run, 3 had same CP) CPs: 3 deaf, 5 hearing
CP Rate of Correct Responses	M = 68% (SD = 14%) Range: 41%–84%	M = 80% (SD = 9%) Range: 66–91%
CP Comprehension Based on Hearing Status	Deaf: M = 71% (SD = 9%) Hearing: M = 65% (SD = 18%)	Deaf: M = 86% (SD = 7%) Hearing: M = 76% (SD = 10%)
CP Comprehension Based on Trial Type	With Distractor: 34% correct No Distractor: 66% correct	With Distractor: 41% correct No Distractor: 59% correct
HS Productions on CP's Incorrect Responses	No modifier: 56% CP not understanding: 9% Unclear modifier: 28%	No modifier: 40% CP not understanding: 30% Unclear modifier: 15%
Logistic Mixed Effects Model	Presence of distractor item significantly predicted modifier usage ($t = 2.22$, $p < 0.05$)	Presence of distractor item significantly predicted modifier usage ($t = 3.995$, $p < 0.001$)
Modifier Production on Trials with a Distractor	Individuals over 50%: 5 (of 7) Overall: modifiers (57%) > nouns alone (43%)	Individuals over 50%: 7 (of 8) Overall: modifiers (60%) > nouns alone (40%)
Modifier in Utterances on Trials with a Distractor Item vs. No Distractor	Distractor: M = 57% (SD = 27%) None: M = 44% (SD = 24%)	Distractor: M = 68% (SD = 16%) None: M = 44% (SD = 10%)
Subsequent Productions	Mod (73%) > Nouns (27%)	Mod (76%) > Nouns (24%)

Overall, both iterations of the task found similar results (Table 3). As a whole, most participants tended to produce more modifiers on necessary trials (i.e., trials with a distractor

item that would need a modifier to distinguish the two items). This suggests that the referential communication paradigm did, as a group, encourage homesigners to produce more modifiers. Deaf communication partners also marginally outperformed hearing communication partners both times suggesting that experience using a visual-manual language may improve comprehension.

Study 1b: Pragmatic Pressure to Produce Agents, Patients and Actions

Do homesigners show evidence of pragmatic understanding by producing agents, patients, and actions (all relevant information) when necessary?

Similar to the Noun-Modifier Pragmatics Task, we also ran an Event Pragmatics Task to see if participants would produce all necessary information (i.e., agent, patient, action) when the task demanded it. Because the stimuli were more complex and involved more elements, and because the content of the distractor items overlapped more with the target event (e.g., videos showing a different action, different agent or patient, swapped agent and patient), participants had to provide more information. There is simply more information to convey in the Event task; thus this task seemed harder than the Noun-Modifier task. One of the goals of this task was to reduce argument dropping. We know that homesigners produce agents and patients, but not necessarily consistently (e.g., Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005; Flaherty, 2014; Coppola, 2002), so the design of this task, which included three contrastive videos, should encourage homesigners to produce all three elements of interest (i.e., agent, patient, action). This task also hinges on homesigners' pragmatic understanding (e.g., knowing that their communication partner needs enough information to be able to select the correct video). In this first analysis, I just looked at the presence of all three important elements and communication partners' comprehension performance.

Participants

Eight homesigners and six communication partners participated in this task (in March 2023). Two of the homesigners acted as each other's communication partners; each described a different set of stimuli when they were the producer. Four of the communication partners (including the two homesigners who swapped producer and comprehender roles with each other) were deaf and four were hearing. See Chapter 2 for more details about the participants.

Procedure

The Event Pragmatic Task was always run after the Noun-Modifier Pragmatic Task and used a similar paradigm in order to put pragmatic pressure on homesigners to produce agents, patients and actions in the same utterance for each trial. The setup for this task was the same as the Noun-Modifier Pragmatics Task, except all of the stimuli were shown on a laptop instead of on laminated paper cards.

The stimuli included 18 trials; each trial included four videos of simple events involving two people (e.g., chasing, spinning, hugging, lifting, pushing) (Figure 4; see Appendix C for full stimuli list). Both the homesigner and the communication partner watched each of the four videos, then a circle appeared in the homesigner's version of the stimuli that identified which video they should describe to the communication partner, who then had to pick the corresponding video. If the communication partner picked the wrong video, the homesigner was directed to try describing the event again. As shown in Figure 4 below, still images depicting the argument structure of each video event remained on the screen for both the homesigner and the communication partner so that they did not have to remember the actions and participants. There were two versions of the task, which did not contain identical stimuli in a different order, but rather slightly different combinations of the characters, roles and events.

Similar to the test trials on the Noun-Modifier Pragmatics Task, each of the video events were quite similar (e.g., doctor chasing firefighter [target], firefighter spinning doctor [different action], construction worker chasing firefighter [different agent], firefighter chasing doctor [swapped agent and patient]). Since all of the events were so similar, communication partners needed the homesigner to produce all three elements (agent, patient and action), as well as make the argument structure clear, in order to choose the correct video. The goal of this task design was to encourage homesigners to produce all of the relevant information. Critically, on all test trials, there was a role-switched version of the target event (e.g., dancer lifting baseball player vs. baseball player lifting dancer) in an effort to put pressure on homesigners not just to produce signs for both people involved in the event, but also to distinguish the agent and patient.

Task Orientation

Before the test trials, participants were shown brief videos of each individual character featured in the videos (e.g., doctor, construction worker, firefighter, baseball player, soldier, dancer, bride, priest), and the homesigner was directed to come up with a sign for each character to facilitate reference to that character during the test trials. Additionally, before the first event was shown, the experimenter showed the communication partner's screen to the homesigner to make it clear that the communication partner was viewing the same four events each time. All participants completed the Noun-Modifier Pragmatics Task before the Event Pragmatics Task, so they were familiar with the setup and procedure.

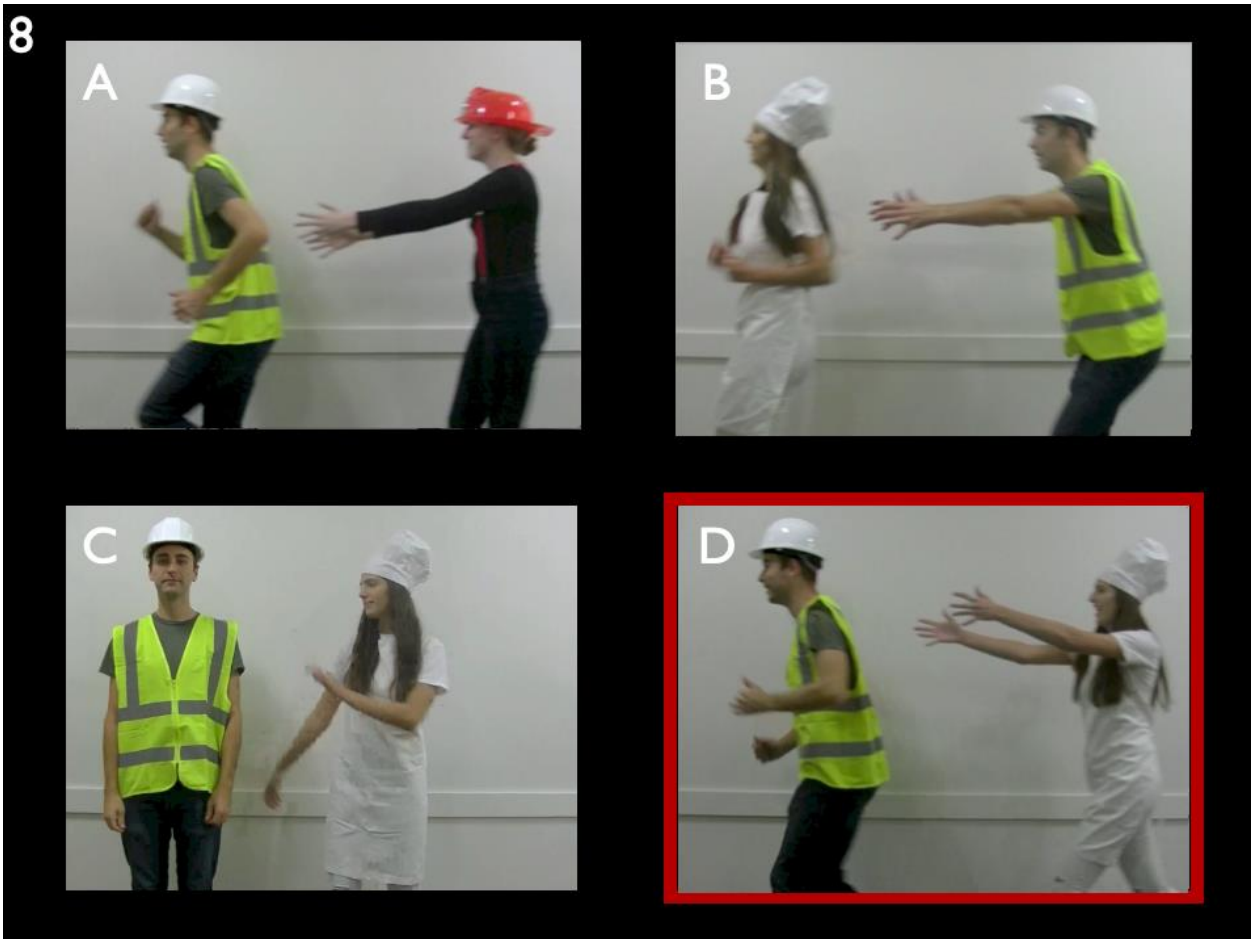


Figure 4. Example of experimental design for the Event Pragmatics Task. The target event (chef chases construction worker) is contrasted with swapped agent-patient (B- construction worker chases chef), a different agent (A- firefighter chases construction worker), and a different action (C- chef spins construction worker). In order for the communication partner to select the correct event, the homesigner must produce (and distinguish) the agent, patient and action.

Coding and Analyses

This coding and analysis was similar to the Noun-Modifier Pragmatics Task. I coded, for each trial, the presence of signs referring to the agent, patient, and action. Signs were coded as expressing the *agent* role if they referred to the character in the video who performed the action (e.g., the person punching or hugging), either using a label (e.g., MAN, WOMAN, CLOWN, PRIEST) or a series of descriptions (e.g., BIG-HAIR ROUND-NOSE DOTS-ON-SHIRT or ROBE

LONG BLACK COLLAR PRAY). Signs were coded as expressing the *patient* role if they referred to the character in the video who was receiving the action (e.g., the person getting punched or hugged) either using a label or a series of descriptions. Signs depicting the action (e.g., PUNCH or GET-PUNCHED) were coded as *action*. Inter-rater reliability for glossing signs for element types was 92%. I also calculated an initial percent correct score for each homesigner and communication partner pair.

For this analysis, I focused on homesigners' initial productions, meaning the first utterance the homesigner produced, before communication partners provided any feedback (e.g., selecting the wrong video, asking for clarification, requesting more information). I did not include subsequent responses in this analysis because homesigners may alter their later productions after receiving feedback from communication partners (see Goldin-Meadow et al., 2015). With this information, I assessed how often homesigners were providing all three necessary elements to determine if this elicitation paradigm did in fact lead homesigners to produce agents and patients in the same clause. The main analyses for this study were (i) descriptive information about how often each of the three elements (agent, patient, action) were present in an utterance, and (ii) testing if the percent correct (communication partner's initial answer) was above the level of performance expected by chance (25%).

Results

Homesigners' Productions

I found that 5 homesigners (out of 8) produced all three elements (i.e., agent, patient, action) on over 75% of their initial utterances and one homesigner produced all three elements in over half of their initial utterances (Figure 5). Only two homesigners, 19 and 21, who were both newly recruited participants, did not frequently produce all three elements (agent or patient +

action or just the action). On average, homesigners produced all three elements on 12.4 trials (SD = 6.9; 69% of trials). But when the outliers were removed (Homesigners 19 and 21 rarely/never produced all three elements), the mean increased to 15.8 trials (SD = 2.8; 88% of trials).

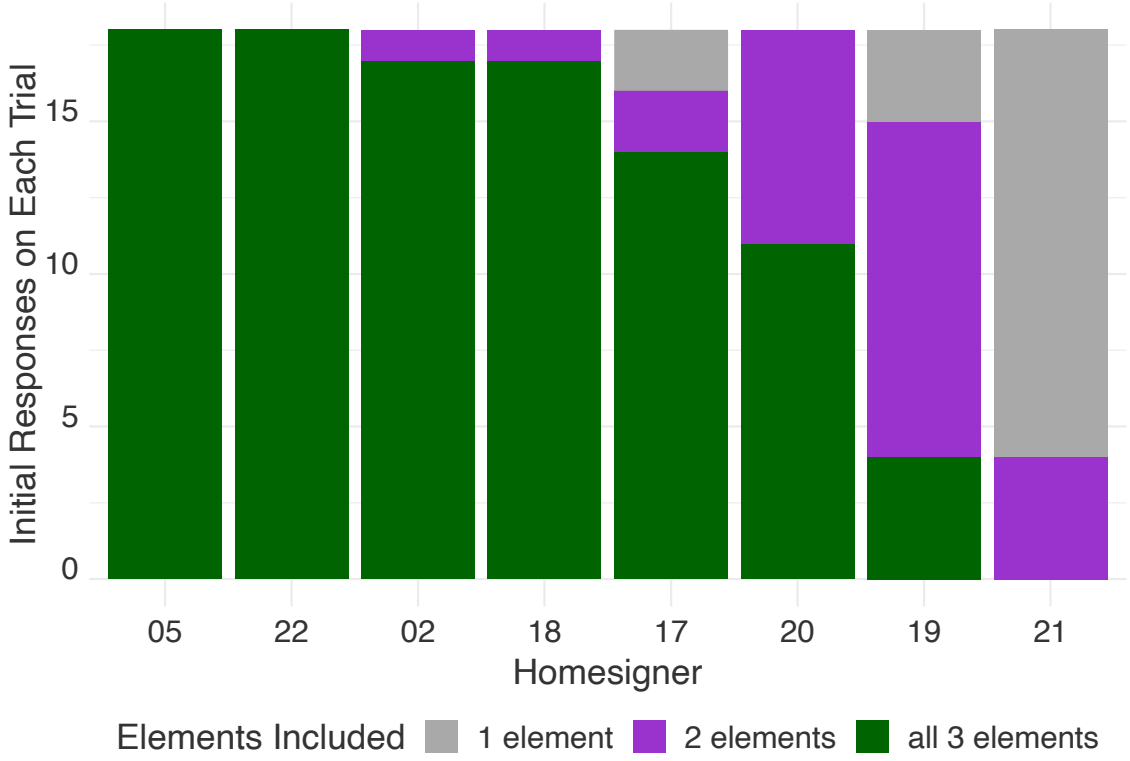


Figure 5. Four homesigners produced all three elements significantly more often than not. Six homesigners produced all 3 elements (agent, patient, action) on more than 50% of trials.

Of the elements produced on initial productions, actions were produced slightly more often than agents or patients. Two-sample proportion tests indicated that while there was no significance difference between the proportion of actions produced (91%) and the proportion of agents produced (83%) ($Z = 1.94$, $p = 0.052$), there was a small significant difference between the proportion of actions (91%) and patients (81%) produced ($Z = 2.38$, $p = 0.02$). However, this effect may be driven by a few individuals since half of the participants produced all three elements on all 18±1 trials.

Most participants did not display practice effects; 6 participants produced utterances with all three elements at the same rate for both the first and second halves (Figure 6). However, two participants did produce more utterances with all three elements in the second half of the task (Homesigner 17: 56% in first half, 100% in second half; Homesigner 20: 44% in first half, 78% in second half). Therefore, two out of eight participants did exhibit practice effects, producing utterances with more relevant information as the task went on.

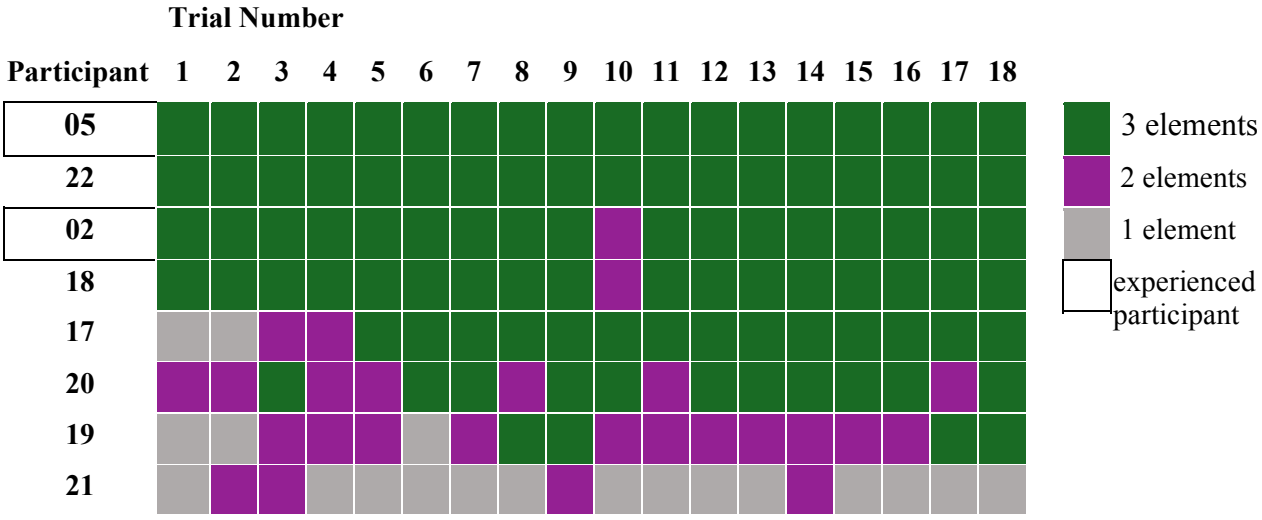


Figure 6. Number of elements produced in initial productions, by trial number . Numbers at the top correspond to the trial number. Green boxes indicate that the homesigner produced all three elements on that trial, purple corresponds with 2-element productions and gray corresponds with single-element productions. The codes of experienced participants are indicated with a black outline. For example, homesigner 17 produced 1-element utterances on the first two trials and 2-element utterances on trials 3 and 4, but produced utterances with all three elements on the rest of the trials (5-18). Note that there were two versions of the stimuli so, for example, while both homesigner 02 and 17 produced 2 elements on trial 10, they saw different stimuli.

Communication Partners' Comprehension

Correct responses based on homesigners' initial productions ranged from 28% to 56% . Communication partners on average got 41% (SD = 11%) of trials correct on their first response.

This task was indeed more difficult than the Noun-Modifier Pragmatics Task (which had a mean initial correct response rate of 68% (SD = 14%)), which was not surprising since there were more distractor items in this task (3 similar events vs. 1 similar item plus 2 unrelated items). to The level of performance expected by chance was 25% (since there was a 1 in 4 chance of guessing the correct answer randomly); three communication partners (those of Homesigners 02, 19, and 21) responded at rates close to chance (28%). The other five communication partners responded above the level of performance expected by chance, but still only one answered correctly more than half the time. Interestingly enough, the one communication partner who had a correct response rate of 56% was actually another homesigner (Homesigner 17) who participated with his friend (Homesigner 18). Outside of this study, we also ran this task with a deaf LSN cohort 1 signer (the husband of Homesigner 22) producing and an experimenter who was also a deaf cohort 1 signer in the role of the communication partner, and their rate of correct responses was still only 56%, indicating that this was a very difficult task overall.

Error Analysis

As expected, most (60%) incorrect responses were agent-patient foils (i.e., swapping the agent and patient; e.g., "bride hugs clown" instead of "clown hugs bride"). There were no major differences in frequency between any other incorrect responses (13.5% wrong agent, 13% wrong patient, 13.5% wrong action).

Next, I compared CP responses that included all three relevant elements (regardless of role assignment, which included the correct target and the agent-patient foil) versus CP responses that included an incorrect element (wrong agent, patient or action). Chi-squared tests indicated that communication partners were more likely to pick a response with all three relevant elements (i.e., a video containing both correct characters and the correct action, on average 75% of the

time) than a response that had an incorrect element (e.g., incorrect character or action) ($X^2(1, N = 146) = 17.87, p < 0.001$). CPs understood homesigners to an extent; they were more likely to select a video that had the correct characters and action, regardless of whether they were selecting the correct agent-patient pair. However, while generally, communication partners were able to understand which two characters and which action was involved, they were responding at the level of performance expected by chance when they had to distinguish which character was the agent and which was the patient. On average, communication partners chose the correct target 49% of the time over the switched agent-patient foil. Communication partners were more likely to choose a response with all three correct elements, but they were not able to distinguish between agent and patient roles for the two characters and were often at the level of performance expected by chance.

Factors That Could Influence Comprehension

Carrigan and Coppola (2017) found that age of exposure to homesigning and experience from birth communicating in a visual manual modality influenced comprehension of homesigners' productions. Younger participants (e.g., siblings) were better at comprehending homesign utterances out of context than were older participants (e.g., their parents). Additionally, Deaf ASL signers who had been exposed to ASL from birth, and who had never met the homesigners, performed best overall on comprehending the homesigners' productions. In three of four cases, ASL signers performed significantly better on the comprehension task than did the homesigners' mothers, who had decades of experience using their offspring's homesign system, and who had contributed to developing it.

Although we had only a few participants, I compared communication partners' comprehension scores based on their ages and their hearing status. I did find a positive

correlation between correct responses and age ($r(6) = .76$, $p < 0.05$), indicating that the older a communication partner was, the better they were at comprehension. However, given the very small N, we cannot put a lot of stock into this finding.

Next I looked at communication partners' hearing status. The deaf CPs performed marginally better (46%) than the hearing CPs (32%), most of whom were performing around the level of performance expected by chance, which was 25%. Notably, 3 out of 4 hearing CPs were responding around chance, but no deaf CPs were at chance. While there does appear to be a trend of deaf communication partners responding correctly on more trials than hearing communication partners (Figure 7), chi-squared tests and Wilcoxon rank-sum tests indicated that there was not a significant difference. Again, however, this may be an issue of power and a small N.

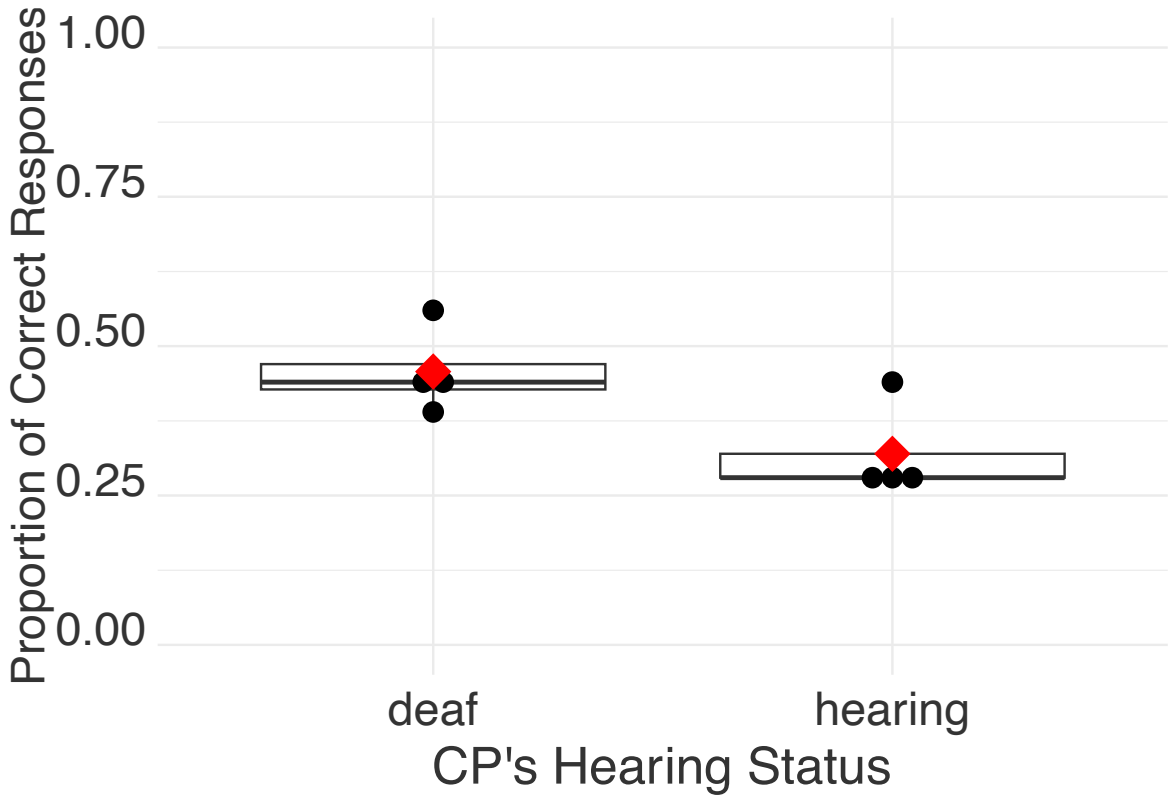


Figure 7. Deaf communication partners (CPs) tended to have more correct first responses than hearing CPs; however, the difference was not statistically significant. Red diamonds represent the mean.

Overall trends for all three runs of the pragmatics tasks (both versions of the Noun-Modifier task and the Event task) suggest that deaf CPs tended to answer correctly more often than hearing CPs (Figure 8). This difference is most pronounced on the Event Pragmatics Task, but the trend can be observed on the Noun-Modifier Pragmatics Task as well.

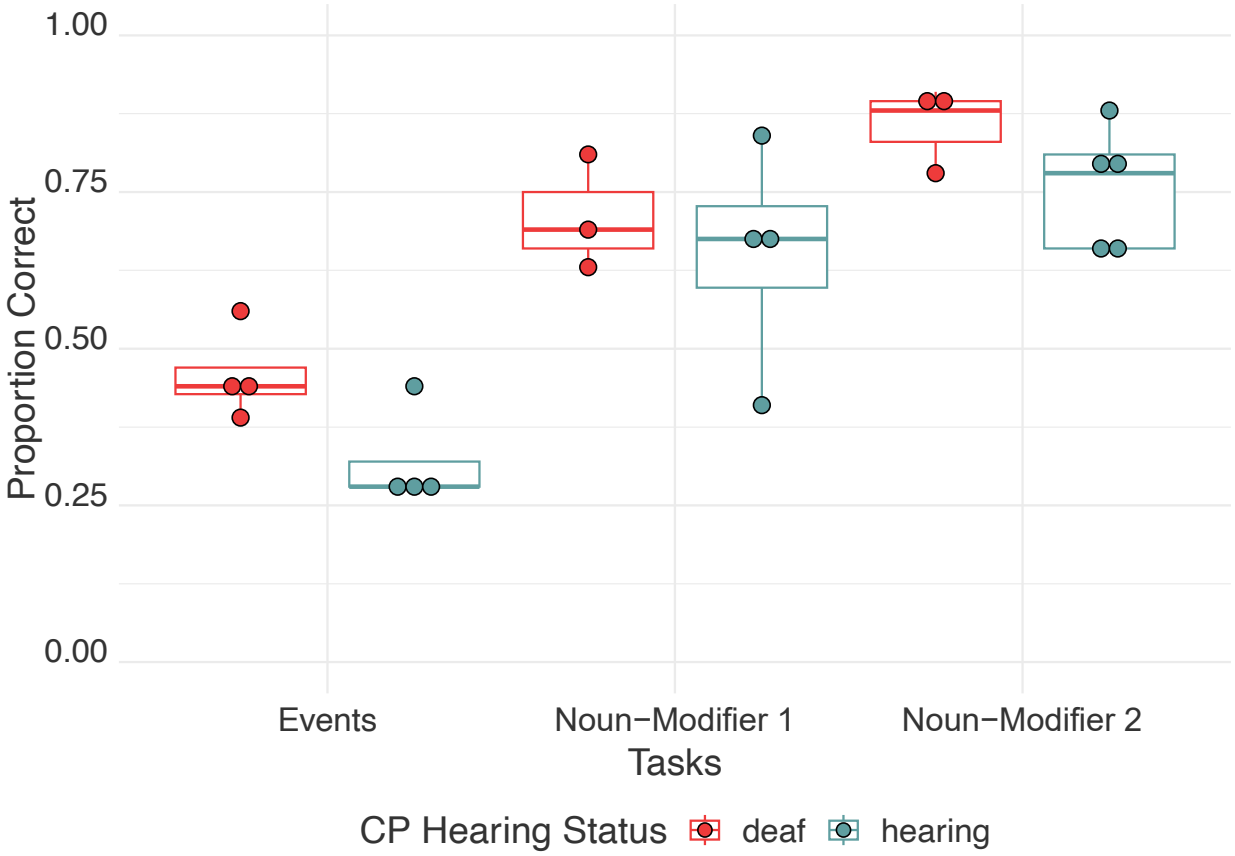


Figure 8. The proportion of correct first responses given by communication partners (CPs) on the following tasks: Event Pragmatics Task ("Events"), first run of the Noun-Modifier Pragmatics Task ("Noun-Modifier 1"), and the second run of the Noun-Modifier Pragmatics Task ("Noun-Modifier 2"). Deaf CPs tended to have more correct responses than hearing CPs, however, the difference was most pronounced on the Event Task. Each dot represents one CP; the thick line in the box represents the median.

Finally, I asked whether there is a relationship between homesigners producing all three elements and communication partners' proportion of correct responses. Chi-squared tests

indicate that communication partners were more likely to respond correctly when homesigners produced all 3 elements in their initial production (39% of trials) compared to when they did not (i.e., only produced 1 or 2 elements; 16% of trials) ($X^2(1, N = 144) = 7.03, p < 0.01$) (Figure 9). However, even when homesigners produced all three elements, communication partners still did not answer correctly 61% of the time. This was not the case for any correct response (initial correct and subsequent correct responses), likely because clarifications in subsequent responses do not necessarily need to contain all 3 elements since some of the elements have already been established in the initial utterance.

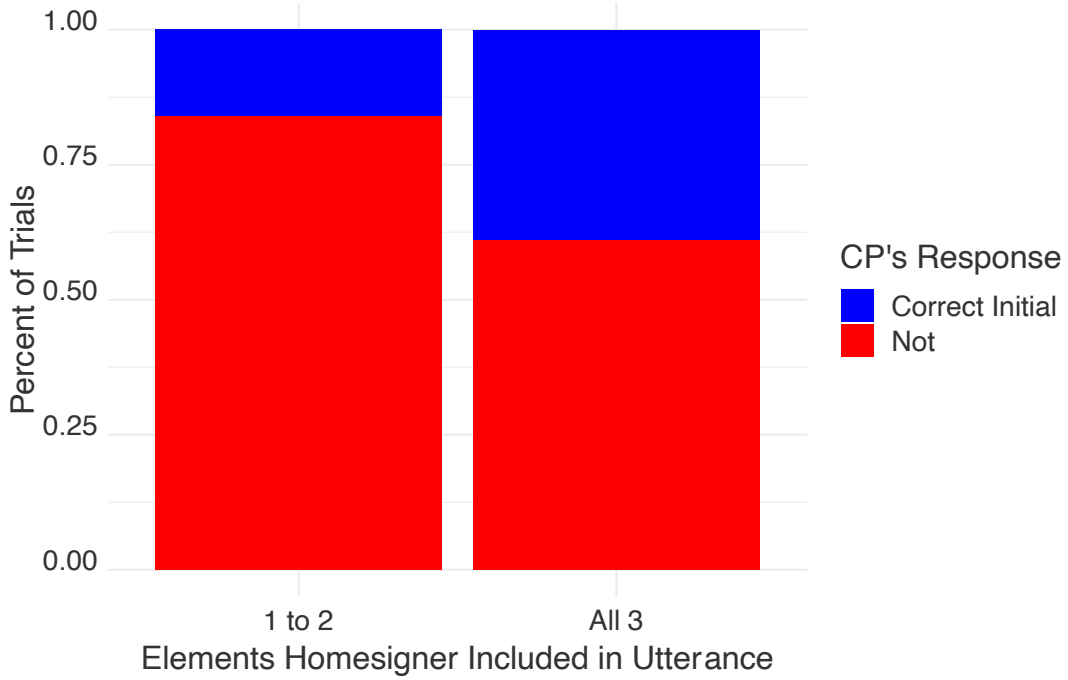


Figure 9. Communication partners (CPs) answered correctly more often when homesigners' initial productions contained all three elements (agent, patient, action) than when they only contained one or two elements.

Summary and Discussion

Most homesigners produced all three elements of interest (agent, patient, action) on more than half of the trials, and 5 did on more than 75% of trials. Communication partners' correct

responses ranged from 28% to 56% based on homesigners' initial productions. Deaf CPs performed numerically, but not statistically better on the task than hearing CPs, though the distributions of scores are suggestive (Figures 7 and 8). Although communication partners did respond correctly on significantly more trials when homesigners produced all three elements, they still responded incorrectly on 61% of trials, indicating either that this was still not enough information, or that CPs did not understand the way the homesigners indicated the argument structure of the event. Given the error analysis, which found that CPs were more likely to select a video that contained all three correct elements but were at the level of performance expected by chance when choosing between the correct video and the video with the agent and patient swapped, this suggests that CPs need more than just the production of the three elements; they also need homesigners to distinguish the agent and patient. It is not enough to just produce two characters and an action, in order to select the correct video, participants also must know who is doing what to whom. In the following chapter, we look at how homesigners distinguish thematic roles when describing these events.

Discussion

Overall, I found that homesigners do use pragmatic information and produce relevant information. I'll discuss these findings briefly here and elaborate further in the overall discussion in Chapter 5. Specifically for nouns and modifiers, homesigners reliably produced modifiers when it was pragmatically necessary. Regarding events, most homesigners produced agents, patients and actions on most trials; however, this might still not be enough information to choose the correct answer because it does not take into account which character is the agent and which is the patient; simply stating the characters involved is not enough. It is not yet clear whether the issue is the homesigners' productions (i.e., not distinguishing characters as agents and patients)

or CPs' comprehension (i.e., not understanding the way homesigners are distinguishing characters) or a mix of both. We did not observe CPs or homesigners using signs that could be glossed as specific WH-words, either in these sets of tasks, in previous director-matcher communication tasks, or in spontaneous conversation. This does not necessarily mean that they do not have WH-words, but having so many opportunities to use them and failing to is suggestive.

Nevertheless, it does seem that both versions of the referential communication task were successful at encouraging homesigners to produce more information, particularly when comparing rates of modifier and argument production in previous studies using different elicitation materials. In terms of modifiers, Do and colleagues (under review) reported that all four Nicaraguan adult homesigners (three of whom also participated in the studies reported here) produced a maximum of 5 utterances with modifiers (mean = 3.5, SD = 1) during the entire task (19 trials). Whereas, in the current study (32 trials, 16 of which were designed to prompt modifier production), the minimum number of utterances with a modifier produced by a homesigner was 5. On the first run, the average number of utterances produced with a modifier was 16 (SD = 8) and on the strict run, the average was 17 (SD = 3.5). In other words, in Do and colleagues' (under review) study, homesigners produced modifiers on average in about 18% of utterances, while in the current study homesigners produced modifiers on average in about 51% of initial utterances. This drastic increase in modifier production may likely be related to the different elicitation methods. Do and colleagues' (under review) stimuli (originally from Abner et al., 2019) did not put pragmatic pressure on participants to produce modifiers. In fact, the original stimuli were designed to assess a noun-verb contrast, therefore, it may not be a surprise

that vastly more modifiers were produced with stimuli explicitly designed to encourage modifier production.

Similarly, with regard to agents, patients, and actions, previous work with homesigners and Nicaraguan signers has reported a great deal of argument dropping. Flaherty (2014) found that of all the utterances produced by homesigners and LSN signers (N=1175), only 16% of them contained two arguments (subject/agent and object/patient). Although she did not provide information about homesigners' productions separately, we can assume that their rate of producing agents, patients and actions is around the same as the total reported number, if not lower. In a similar vein, Senghas, Coppola, Newport and Supalla (1997) found that in descriptions of events with two animate arguments (e.g., Person A does Action to Person B), LSN signers never produced utterances with two nouns and a verb. However, Cohort 1 signers did use paired verb constructions (e.g., N_1 V_1 N_2 V_2 or MAN PUSH WOMAN FALL). In contrast, Coppola (2002) found that homesigners produced agents with actions on a majority of utterances (65-79%). However, Coppola (2002) did not always identify which of those utterances also included a patient, so it is difficult to know what percentage of homesigners' utterances actually contained all three relevant elements. The current study found that overall homesigners did produce all three elements (agent, patient, action) on a majority of trials (69% of trials for all homesigners; 88% for homesigners with two outlier participants removed). Compared to previous studies, the current study stimuli did dramatically improve the rate of all three elements produced. Given the amount of utterances with two arguments and an action, plus the amount of modifiers that were produced in the other study, it seems as though this study paradigm (referential communication task) was successful in encouraging homesigners to produce more information than they might originally provide with different stimuli.

I observed some practice effects in both studies, which may be another indication of pragmatic understanding. In the first run of the Noun-Modifier Pragmatics Task, three communication partners' correct response rates improved as the task went on and three homesigners produced more modifiers in the second half of the task. However, only one homesigner/CP pair had both more modifiers and more correct responses in the second half. In the second strict run of the Noun-Modifier Pragmatics Task, while CP comprehension was slightly higher than the first run (80% on average versus 69% average correct), the rate of modifier production, specifically on trials with a distractor item, remained relatively consistent (modifiers were produced on 57% of initial utterances on a trial with a distractor item on first run, and 60% on the second strict run). On the Event Pragmatics Task, only two out of the eight participants demonstrated practice effects, producing more utterances with all three elements in the second half of the task. All together, practice effects did occur, but not consistently across all participants.

Another interesting finding was that overall deaf CPs performed marginally better than hearing CPs on all tasks. This is not surprising given Carrigan and Coppola's (2017) findings that Deaf ASL signers unfamiliar with the homesigners' system were still better at comprehension compared to the homesigners' mothers. Deaf CPs' language experience was also varied; this group included homesigners (who also participated and acted as each others' CPs), LSN signers (from a variety of cohorts and timing of language exposure), and one experimenter who knew both ASL and LSN. However, all of the deaf CPs had experience communicating in the visual-manual modality, which likely aided their comprehension on these tasks. It seems that this language experience is important for understanding, and could be related to the slow rate at which homesign language systems conventionalize (Richie, Yang & Coppola, 2014; Quam,

Brentari & Coppola, 2022). Communicative interactions may not be enough, a linguistic community may be necessary.

Studies 1a and 1b suggest that homesigners do exhibit pragmatic knowledge. This aligns with Safar and de Vos' (2022) findings that homesigners in Bali use pragmatic knowledge and engage in other-initiated repair with hearing communication partners. Critically, the novel elicitation tasks, specifically designed to encourage participants to produce more information, were successful at doing so by leveraging homesigners' pragmatic understanding. Further considerations into the nature of pragmatic knowledge, especially when someone does not have a language model and typical linguistic interactions, will be discussed more in Chapter 5. As it stands, homesigners in the current study produced more modifiers and did less argument dropping than observed in previous studies, likely related to the referential communication paradigm and contrastive stimuli used in both tasks. Using pragmatic pressure could be useful when designing elicitation stimuli, particularly when trying to capture something that occurs less frequently in other instances (e.g., natural conversation, other elicitation paradigms).

Chapter 4. Event Representation

Background

It has been well established that thematic roles, like agent and patient, exist as an integral part of language; however, despite cross-linguistic research with adults and infants, it is still unclear the extent to which language influences the development of these abstract categories (e.g., Rissman & Majid, 2019; Strickland, 2017; Fillmore, 1968; Dowty, 1991). Thematic roles may exist because language creates these syntactic and semantic categories; alternatively, there may be some kind of underlying universal concepts that exists prior to the influence of language (e.g., Connor, Fisher & Roth, 2013; Strickland, 2017; Chang, Dell & Block, 2006; Hafri, Trueswell, & Strickland, 2018). While these two theories strongly contrast with each other, it is also possible that the reality lies somewhere between these two views, and that the influence of language on the development of these concepts falls somewhere in between these endpoints. While there has been research into homesigners' production of agents and patients (e.g., Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005; Flaherty, 2014; Coppola, 2002), because of the prevalence of argument dropping, it has been difficult to assess their relative treatment within a single utterance. Therefore, using tasks that encourage homesigners to produce all relevant information and/or tasks that do not require language but can assess the nonlinguistic aspects of these concepts should be employed.

Evidence for Universal Underlying Concepts of Agent and Patient

One theory posits that language is not necessary, and instead proposes that humans have universal core concepts of agents and patients. Dowty (1991) argued for the existence of thematic proto-roles in which players involved in events can be represented broadly by proto-agents (entity that causes change) and proto-patients (entity that undergoes change). Without a

clear, explicit operationalization of what these representations entail though, these semantic categories can sometimes get a little fuzzy.

Most of the evidence in support of this theory comes from infant studies. Many habituation and preferential looking studies with infants suggest that even very early in life, infants may have some sort of concepts analogous to agent and patient (e.g., Woodward, 1998; Golinkoff & Kerr, 1978; Gordon, 2003; Wagner & Lakusta, 2009). Six-month-old infants were able to perceive cause-and-effect relationships (a key factor in understanding the concepts of agent and patient) and were found to dishabituate when roles were reversed (Leslie & Keeble, 1987). Looking time and habituation studies have also found that infants 14 to 24 months of age notice when agent and patient roles are switched (Golinkoff, 1975; Golinkoff & Kerr, 1978). Additionally, 10- and 12-month-olds were able to perceive an event as causal, looking longer when observing a human hand emerge after performing an action, compared to an inanimate object (Saxe, Tenenbaum & Carey, 2005). Because infant studies must rely on looking time and habituation measures, they are often open to rich interpretation, so it is not totally clear whether infants have agent- and patient-like concepts similar to those of adults, or if they are only noticing a change in the stimulus.

A few studies with adults have tried to fill in this gap; however, it is somewhat difficult to remove the impact of language on these concepts in typical adults whose brains have developed in the context of exposure to a full natural language. In an effort to minimize this inevitable linguistic influence, researchers have used methodologies like eye tracking and measuring reaction times. Indeed, agents have been found to be more salient than patients in both eye-tracking studies (e.g., Wilson et al., 2011; Cohn & Paczynski, 2013) and reaction time studies (e.g., Hafri, Trueswell & Strickland, 2018). Adults were able to very quickly discriminate

between agents and patients when briefly shown images of simple events for both 73 and 37 milliseconds (Hafri, Papafragou & Trueswell, 2013). Rissman and Majid's (2019) literature review concluded that there is evidence for the existence of abstract concepts of agent and patient and a universal bias towards distinguishing the two, but this universal abstract concept was not observed for other thematic roles (e.g., goal, recipient, instrument).

While there seems to be a lot of evidence in favor of this theory, it is important to note that much of it is based on looking time, habituation, and reaction time methods, all of which are open to rich interpretations. Furthermore, infants may not be the best population to investigate abilities in the absence of language since in typical development, infants are being exposed to language basically immediately. Of course, it takes time for infants to actually acquire language, but even as early as at 6 months old, infants can already use language to gain knowledge, form categories, and understand concepts (LaTourette & Waxman, 2020). It is possible that infants are using basic linguistic information they have already acquired to aid them in these agent-patient looking tasks. Therefore, we need more evidence from other populations with different language experiences.

Evidence for Language Being Necessary to Develop the Concepts of Agent and Patient

Another theory proposes that language is important/necessary for creating syntactic and semantic categories, and that children develop the concepts of agent and patient as they acquire language. Language acquisition influences cognitive development in many ways including theory of mind (e.g., de Villiers & de Villiers, 2014; de Villiers & Pyers, 2002), labeling and category creation (e.g., (Fulkerson & Waxman, 2007; LaTourrette & Waxman, 2020), relational and analogical concepts (e.g., Doumas, Hummel & Sandhofer, 2008; Gentner & Christie, 2010), and large exact number representations (e.g., Walker et al., 2024; Carey, 2009; Wynn, 1992). It

is entirely plausible that the concepts of thematic roles may also be influenced by the language acquisition process. In a nonlinguistic eye-tracking study with adults and infants, Shukla and de Villiers (2021) found that both groups showed an anticipatory effect (i.e., predictive eye gaze towards the target) for one-argument intransitive events. However, only adults showed an anticipatory effect for reversible two-argument transitive events, while infants (12 to 24 months old) and adults performing verbal shadowing, which they argue suppressed the adults' ability to use language-based concepts, did not. This suggests that language may be involved in the development of agent and patient concepts, or perhaps that language is necessary to engage with such concepts. While these two theories are not necessarily mutually exclusive, it is possible that the influence language exerts on the concepts of agent and patient exists more on a spectrum. Thus, further investigation is required to better understand the relationship between language and thematic role concepts.

Disambiguating Agents and Patients

Word order is a common strategy for distinguishing between agent and patient (e.g., in English, think of the semantic difference between *the cat chased the lizard* versus *the lizard chased the cat*). Although there are a variety of potential word orders, Subject-Verb-Object (SVO or agent-action-patient) and Subject-Object-Verb (SOV or agent-patient-action) are by far the most common across languages, and in even more languages, the subject/agent precedes the verb/action (Dryer, 2005). This agent-patient ordering may be constrained by language or may be conceptually driven outside of the influence of language. Goldin-Meadow and colleagues (2008) found that when hearing nonsigners from a variety of linguistic backgrounds (i.e., speakers of English, Turkish, Mandarin, and Spanish) were asked to describe an event using only gestures, they often used the order Agent-Patient-Action, despite the fact that they would not use

that same ordering when describing the event using their spoken language. Langus and Nespor (2010) replicated these results with Italian speakers and posited that there may be a nonlinguistic conceptual preference (based on semantics) for Agent-Patient-Action (SOV) but a linguistic computational preference (based on syntax) for Agent-Action-Patient (SVO), which is why we see this variety in argument order cross-linguistically.

Because word order in many signed languages is flexible, it may be a little more difficult to determine argument ordering patterns. For example, while Agent-Action-Patient (SVO) is the most commonly accepted word order in ASL (Sandler & Lillo-Martin, 2006), a variety of other factors such as topicalization, classifier construction and aspect marking can influence word order (Fischer, 1996; Liddell, 1980). Additionally, analysis of Nicaraguan Sign Language (LSN) has revealed differences in argument ordering. Cohort 1 had a relatively consistent word order (or at the very least produced a small range of possible word orders), whereas Cohort 2 had more flexible word orders (Senghas, Coppola, Newport & Supalla, 1997). Cohort 1 signers used paired verb constructions as part of their word order (e.g., Agent Action1 Patient Action2 or MAN PUSH WOMAN FALL) for events with two animate arguments, which allowed disambiguation between agents and patients. Whereas Cohort 2 signers used systematized spatial modulations which allowed them to be more flexible with word order while not losing the distinction between agents and patients. Similarly, Kocab and Snedeker (in prep) examined productions from Cohorts 1, 2 and 3 and most participants did not use a consistent word order; the only participants who used a consistent word order more than 75% of the time were signers from Cohort 1.

If languages do not use word order, then what strategies do they use to distinguish agents and patients? Spatial strategies are common in many signed languages to specify argument

structure. Padden (1988) identified spatial verbs and agreeing verbs in ASL which can indicate person and number agreement by using locations of present referents or establishing abstract referential loci (also called R-loci, Lillo-Martin & Klima, 1990). However, studies of emerging sign languages reveal that spatial strategies take time to develop. Padden, Meir, Aronoff, and Sandler (2010) found generational differences in how signers of Al-Sayyid Bedouin Sign Language (ABSL) used spatial axes and verb agreement. Senghas et al. (1997) found cohort differences in LSN signers; Cohort 1 signers did not spatially mark nouns or demonstrate verb agreement, but Cohort 2 signers did show consistent movement patterns for verbs. These differences between cohorts indicate that signers may start to implement spatial strategies that only become fully systematized later as time goes on. Furthermore, Senghas and Coppola (2001) found that Cohort 2 signers who were exposed to LSN before the age of 10 used not only more spatial strategies than Cohort 1 signers, but also used the movement of their verbs in space more systematically to indicate co-reference (i.e., verb agreement). This highlights the importance of early exposure to a language model as well as peer-to-peer (or horizontal) contact. Flaherty (2014) also found that for LSN signers, the amount of verbal spatial agreement increased with each cohort. Evidently, spatial strategies are important for distinguishing agents and patients, but often take time to develop and conventionalize.

Structure in Homesign Systems

As previously stated, homesigners create complex linguistic systems that more closely resemble sign languages than they resemble gestures produced by hearing nonsigners (Brentari et al., 2012; Horton et al., 2015). With minimal linguistic input, they are able to innovate linguistic structures, the most relevant here being argument structure and use of spatial strategies.

Word Order and Argument Structure

Earlier research on the treatment of arguments in homesign systems suggests that homesigners do produce agents and patients and may show ordering patterns, but not consistently (e.g., Goldin-Meadow & Mylander, 1998; Coppola & Newport, 2005; Flaherty, 2014; Coppola, 2002). Goldin-Meadow and Mylander (1998) found that both American and Taiwanese homesigning children demonstrated regularities in their argument ordering, often producing Subject-Verb or Object-Verb clauses. They were also more likely to produce patients than agents. Culture did not seem to greatly impact argument ordering as both American and Taiwanese children showed similar patterns, despite growing up surrounded by spoken languages with different structures. However, language experience did have an impact on the hearing mothers, who did not show the same ordering patterns as their deaf children, suggesting that this argument ordering originated with the deaf homesigning children. In another study, Coppola and Newport (2005) found that adult homesigners typically placed Subjects at the beginning of clauses, however, their study was designed to see whether both agents and non-agents (e.g., patients) were treated similarly in homesigners' grammars, leading them to be considered as grammatical Subjects. While many of these studies observe patterns in homesigners' productions, because not all of the components (e.g., agent, patient, action) are reliably produced in the same clause, it is difficult to contrast the treatment of agents and patients in homesigner's productions with respect to ordering.

While earlier research has demonstrated that homesigners express the concepts of agent and patient, previous work has not been able to fully characterize the relative treatment of agents and patients in homesign systems because the elicitation materials and procedures did not reliably elicit productions containing all of the elements of interest (agent, patient, action) in the

same clause. To illustrate, Flaherty's (2014) dissertation analyzed 1175 utterances produced by homesigners and only 16% (190) of these utterances included two noun arguments that could be identified as a subject and an object. Similarly, Coppola's (2002) dissertation revealed that homesigners produced agents in combination with actions in 65-79% of utterances, but did not disambiguate what percentage of utterances contained both an agent and a patient with the action.

Because argument dropping, which does occur in many other languages like Spanish, is common in homesign and sign languages in general, elicitation tasks and procedures must be designed to encourage elicitation of all of the arguments of interest. In other words, there must be task demands to produce both agents and patients in a single clause, because if not, a homesigner may not be inclined to automatically produce both arguments on every trial.

Use of Spatial Strategies

Studies with emerging sign languages like LSN and ABSL suggest that spatial strategies take time to develop in a new language, so what does this mean for homesign systems? Coppola and So (2006) analyzed elicited productions from four Nicaraguan homesigners and four American hearing non-signing college students and found that all participants used spatial modulations and coreference in their signs and gestures. However, homesigners' use of spatial modulation and coreference was more constrained than the hearing gesturers' (e.g., homesigners spatially modulated signs for actions but not for nouns, whereas hearing gesturers used spatial modulation for both types of signs). This suggests that homesigners' spatial strategies more closely resemble sign languages than gestures. Coppola and So (2005) also found homesigners resembled Cohort 1 LSN signers with regard to their consistency using a given spatial layout (rotated or unrotated), however Cohort 1 used mixed layouts (combining rotated and unrotated)

more than homesigners, suggesting that there may be small pockets of greater internal consistency among homesigners.

Flaherty (2014) found that when establishing referential loci, homesigners predominantly used strategies involving signing in a neutral space, signing on the body, or signs placed in a non-neutral space. Additionally, when investigating homesigners use of spatial coreferences (i.e., when signs are produced in the same space to refer to the same referent), a majority of homesigners' productions (almost 70%) did not have any verbal spatial agreement (e.g., no nouns were set up in space, so the movement of the verb sign is not actually very informative). There are other spatial strategies used in existing sign languages, like referential shift, in which the signer shifts the position of their body to indicate a new character being referenced (Padden, 1986). However, currently, there does not appear to be any published research about the use of referential shift in homesign systems. Since referential shift is observed significantly more in Cohort 2 signers than in Cohort 1 signers (Kocab, Pyers & Senghas, 2015), it is plausible that referential shift takes time to be incorporated as a spatial strategy and thus would be rarely observed in a homesign system.

Linguistic and Nonlinguistic Abilities

Finally, for the purposes of the following studies, it is important to distinguish between linguistic and nonlinguistic abilities. Linguistic abilities are obviously ones that require language, but nonlinguistic abilities can sometimes be harder to define. For example, performance on nonlinguistic reasoning tasks has been found to be associated with language in a variety of populations (e.g., adults with aphasia: Baldo et al., 2015; Langlan-Hassan et al., 2021; children with language disorders: Gallinat & Spaulding, 2014; Saar, Levanen & Komulainen, 2018;

Durant et al., 2019; and deaf and hard of hearing children with delayed access to language: Quam & Coppola, 2023; Phillips et al., 2014).

Language is enmeshed in almost everything that humans do and even processes that are thought to not involve language typically do at some level. Because of this, it is very difficult to conduct a truly nonlinguistic assessment. Even some tasks that are considered nonlinguistic still use linguistic instructions. Language may be unintentionally recruited or primed, can be used as an alternate strategy (e.g., inner speech: Carruthers, 2018; Perrone-Bertolotti et al., 2014), can scaffold other processes (e.g., spatial reasoning: Hermer-Vazquez et al., 1999; cognitive flexibility: Emerson & Miyake, 2003) and is a conceptual resource that can influence attention, memory and executive functioning (e.g., Lupyan & Bergen, 2014; Fulkerson & Waxman, 2007; Dye and Hauser, 2014; Botting et al., 2013; Goodwin et al., 2022).

Studies using linguistic and nonlinguistic tasks with homesigners can help us to better understand which cognitive processes depend on language and which do not. For example, the core number theory states that the ability to represent small exact numbers (e.g., 1–3) should not require language, whereas representing larger exact quantities does require language (in the form of a counting sequence) (Carey, 2009). This theory is supported by evidence that homesigners can accurately represent small quantities (1–3) (i.e., holding up 2 fingers when shown 2 items), but are much less accurate with larger quantities (4–20) (Spaepen et al., 2011). However, the same study found that in a quantity matching task, homesigners also had lower accuracy representing small quantities when the items were not continuously visible or were intangible (e.g., a series of knocks). In some cases, language experience may play a role in seemingly nonlinguistic tasks as well. Additionally, designing stimuli and tasks that are minimally linguistic and culturally appropriate for homesigners is important, but can be difficult. Often, tasks must be

modified to suit homesigners (e.g., demonstrating the task, rather than telling them instructions). For example, Gagne and Coppola (2017) used an experiential false belief task with homesigners, rather than a traditional narrative version, in order to minimize the influence of language in the task. This task with homesigners was based on Pyers' (2005) task with LSN signers. Without outside linguistic input, homesigners are able to create a great deal of linguistic structures on their own (e.g., morphology (Brentari et al., 2017; Coppola & Brentari, 2014), grammatical subjects (Coppola & Newport, 2005), number inflection (Abner et al., 2022), and spatial devices (Coppola & So, 2006; Flaherty, 2014)). However, they still struggle with some linguistic and linguistic-adjacent concepts without access to a linguistic community (e.g., conventionalized lexicons (Richie, Yang & Coppola, 2014; Quam, Brentari & Coppola, 2022), count sequences (Spaepen et al., 2011), understanding false belief (but they do exhibit perspective taking-abilities; Gagne & Coppola, 2017)). It is necessary to create nonlinguistic tasks or tasks with minimal language demands in order to accurately assess what homesigners know. However, designing nonlinguistic tasks that can be used with homesigners is quite difficult.

Study 2a: Linguistic Representation of Agents and Patients

Do homesigners linguistically represent agents and patients, and if so, what strategies do they use to distinguish them?

Study 1b found that while most homesigners produced all three necessary elements (agent, patient, action) when describing simple events with two animate participants, on average, communication partners still chose the wrong answer on a majority of the trials. Although communication partners were more likely to choose the correct answer when the homesigner provided all three elements, they were often responding at the level of performance expected by chance when distinguishing between agent and patient roles. Most of their incorrect responses

were videos with the agent and patient swapped. Producing signs for the two characters is not enough information; homesigners must also distinguish which character is in which role (agent or patient). To follow up on this, Study 2a investigated how homesigners may be distinguishing agents and patients. I focused on two common strategies— word order and spatial strategies— but noted other devices as well. If we observed homesigners linguistically distinguishing agents and patients, this evidence would support the idea that agents and patients are concepts that exist outside of exposure to language that encodes them.

Participants and Procedure

The participants (8 homesigners, 6 communication partners plus 2 homesigners acting as each other's communication partners) and procedure (Event Pragmatic Task) are the same as from Study 1b. See Chapter 2 for more details about the participants and Chapter 3 for details about the task.

For this analysis, I looked at both initial and subsequent productions. Utterances were classified as initial when it was the first utterance a homesigner produced at the beginning of the trial. Utterances were classified as subsequent when they occurred after the initial utterance and/or after the communication partner responded (e.g., by selecting the incorrect answer, asking for clarification or requesting more information). A homesigner could produce multiple (or zero) subsequent utterances per trial, but only one initial utterance per trial. I specifically focused on initial utterances because homesigners often become less consistent in subsequent utterances (Goldin-Meadow et al., 2015). Goldin-Meadow and colleagues (2015) analyzed homesigners' handshapes for nominals (items), and found that homesigners' internal handshape form consistency was around 50% when restricting analyses to only the first production. However, when all of the homesigners' productions were analyzed (initial and subsequent) their internal

consistency dropped to around 35%. Homesigners also used significantly fewer different handshapes per item on their first response compared to when all responses (initial and subsequent) were taken into account. This was not the case for the LSN signers whose internal consistency remained constant. Since there appears to be a significant difference between homesigners' initial and subsequent responses, I analyzed them separately.

Coding and Analyses

Here, I further analyzed homesigners' productions (also described in Chapter 3) that included both agents and patients to determine their relative treatment. First I analyzed word order within a single utterance to see if homesigners had an order preference (e.g., agent-patient-action, patient-agent-action). However, homesigners did not always produce a single clause that contained all three elements (two arguments and an action). For example, when presented with the event "ballerina tickles chef", a homesigner might first describe the ballerina (woman, red skirt) then describe the chef (woman, tall hat, white clothes, cooking), and finally describe the action (tickles). When they did not produce these three elements within the same utterance, we added a secondary coding for "order of argument mention" across their entire response. This is obviously not the same as word order since not all of the arguments will be in the same clause, but the general order of arguments across the entire production may still provide useful information. The analysis assesses whether homesigners have an argument order preference across a series of clauses that comprise their response to a stimulus item.

Word order is not the only way to distinguish arguments in a sentence. A large majority of sign languages uses spatial strategies to express argument structure. Thus, I also annotated the spatial strategies that homesigners used to distinguish between agents and patients in their productions. While I initially considered using the spatial layout coding schema used by Senghas

and Coppola (2001) or Flaherty (2014), I did not observe very much left/right movement in the signs used to express events in this task. So instead, I annotated preliminary spatial strategies (described in detail later in this chapter).

Finally a note about coding utterances. Each utterance was annotated for element ordering as well as timing, pauses and breaks. Breaks between utterances were annotated when (a) the hands dropped, (b) the thought in the utterance was complete, and/or (c) the duration was longer than 2 seconds. Overall, within-utterance pauses were on average around 0.87 seconds in duration (SD = 0.49). Most pauses were less than 1.7 seconds. In the few cases that pauses were longer than that, they were still deemed pauses rather than utterance breaks when (a) hands did not drop, (b) subsequent signs were a clear continuation of the previous thought before the pause, and/or (c) the homesigner was taking time to think or process but was clearly in the middle of a thought. When describing word ordering, significant pauses were indicated with a comma. For example, P, A-E (patient [pause] agent action) would be different from P-A-E (patient agent action) since in the first example, there would be a pause (either based on timing, brief dropping of hands, or holding a sign) after the patient sign whereas in the second example, the elements would be simply signed in order. For utterances, the pauses could be indicating topicalization, which is a sentence construction in which the topic of the sentence (which can be the agent or the patient) is produced before the rest of the clause and, in signed languages, is marked non-manually (e.g., raised eyebrows, blinks, body position change). While topicalization could potentially be a sentence construction that homesigners use, determining that is out of the scope of this paper. Nevertheless, I still indicated when homesigners used similar constructions and recorded significant pauses and non-manual markers (e.g., P, A-E vs. P-A-E). Lastly, when

discussing word order, in order to easily contrast agents and actions, abbreviations for agents are "A" and actions are "E" (like events).

Results

Argument Ordering

Before diving into the word order for agents and patients, first, I wanted to see if homesigners had general ordering tendencies. In terms of action placement, the most common order was action-final (e.g., patient-agent-action or agent-patient-action). Six homesigners put the action final in the utterance on more than half of the utterances (Table 4). More than half of the utterances produced by the other two homesigners contained a single element or did not have an action and thus could not be analyzed further.

Table 4. The final position in an utterance was the most common placement for actions. Action-final responses were separated into regular action signs coming at the end of an utterance and "sandwiched" action signs, which were constructions that included multiple event signs and an argument (e.g., action-agent-action). Each homesigner produced 18 utterances.

Homesigner	Action Final	Action Final (sandwich)	Action Elsewhere	Single Element / No Action
02	**89%**	5.5%	5.5%	–
05	56%	16%	28%	–
17	**72%**	11%	6%	11%
18	**94%**	6%	–	–
19	44%	–	6%	50%
20	56%	16%	28%	–
21	6%	–	11%	**83%**
22	**89%**	11%	–	–

With regards to argument ordering on initial productions, four homesigners produced more patient-initial utterances and two homesigners produced more agent-initial utterances (Table 5). One homesigner (17) showed no preference and one homesigner (21) produced mostly single-element utterances so ordering could not be classified. Overall, action-initial utterances were rare, which aligns with the previous finding that the most common placement of action signs were at the end of utterances.

Table 5. Proportion of utterances for each homesigner that began with an agent, patient, or action. Each homesigner produced a total of 18 utterances. Single-element utterances only had one sign and thus ordering could not be determined.

Homesigner	Agent-Initial	Patient-Initial	Action-Initial	Single-Element
02	33%	**67%**	–	–
05	33%	**67%**	–	–
17	44%	39%	6%	11%
18	**67%**	33%	–	–
19	**50%**	17%	5%	28%
20	17%	**72%**	11%	–
21	6%	11%	11%	**72%**
22	22%	**72%**	6%	–

Next, I wanted to check whether the placement of characters in the stimulus events influenced argument ordering. A chi-squared test indicated that there was not a significant preference for patient-initial utterances overall (58% of initial utterances) compared to agent-initial utterances (42%), $X^2(1, N = 117) = 1.24$, $p = 0.2$). For initial productions, a chi-squared test revealed a significant relationship between the location that a character was presented, that

is, on the left or right side of the computer screen, and the order in which the argument was produced ($X^2(1, N = 117) = 8.48$, $p < 0.01$). Participants were more likely to produce agent-initial utterances when the agent was appeared on the left side of the video and more likely to produce patient-initial utterances when the patient was on the left side of the video (Figure 10).

However, it is important to note that patient-initial utterances were generally more common than agent-initial utterances (overall 47% of homesigners' utterances were patient-initial versus 34% of agent-initial utterances). Therefore, this difference in argument ordering and character positioning may be skewed by the fact that there are simply more patient-initial utterances.

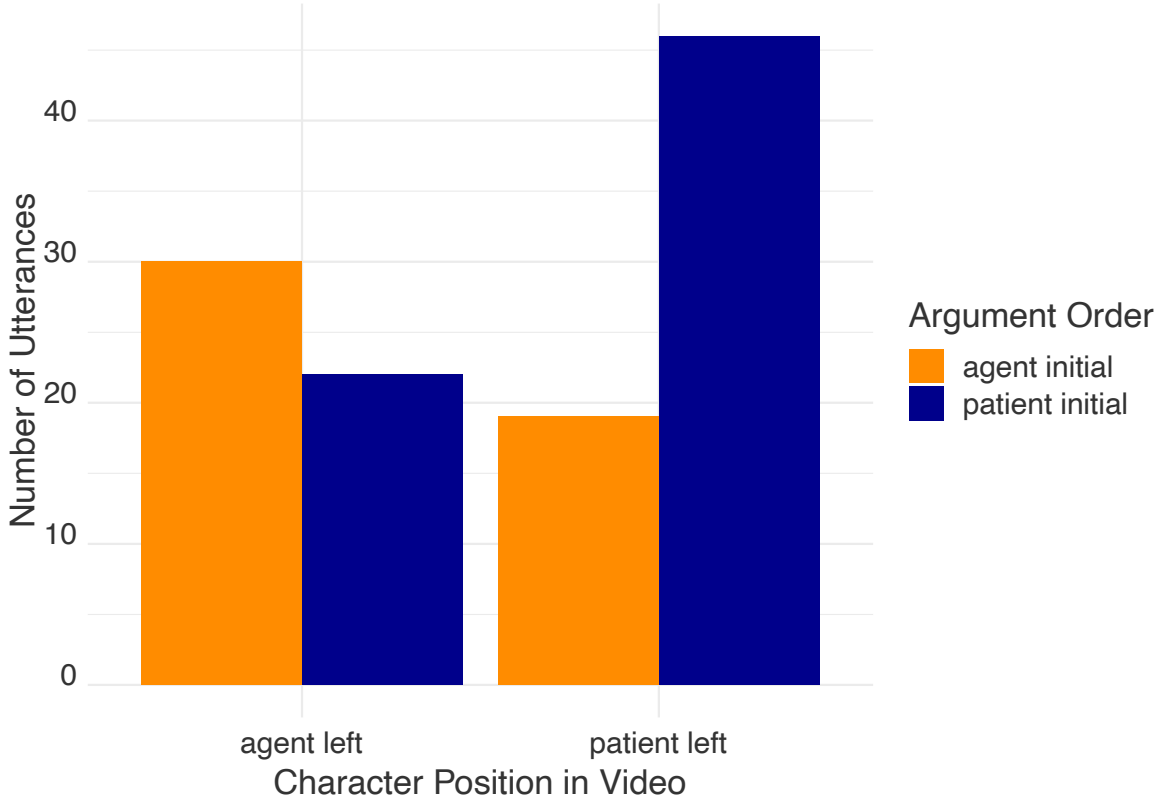


Figure 10. While there was no significant difference in argument ordering when the agent was on the left, when the patient was presented on the left side of the screen, participants were significantly more likely to produce patient-initial utterances.

Word Order

We will start first with homesigners' initial productions because those are less likely to be influenced by communication partners' input (e.g., requests for clarification). Note that Homesigner 21's productions could not be analyzed because he mostly produced one-element utterances (72%). The only two-element combination he produced more than once was patient-agent (produced twice). Similarly, Homesigner 19 only produced 3 three-element utterances. The most common two-element utterances she produced were agent-action (four times) and agent-patient (three times).

Homesigners did not tend to have internally consistent word orders (Table 6). The only homesigner who produced the same order on more than half of the trials was Homesigner 22 (P-A-E (patient agent action) on 56% of trials). Another interesting thing to note is that for three homesigners (17, 18, and 22), their most common and second most common word orders involved the agents and patients switching positions (e.g., P-A-E and A-P-E), which without any more information, would make it incredibly difficult to identify agents and patients based only on word order. To illustrate, if Homesigner 17 signed CLOWN BRIDE HUG, there is a chance the stimulus event being described was 'the bride hugs the clown' but there is also a chance the event was 'the clown hugs the bride'; however, based on word order alone, we would not know.

Some of the word orders may be related to each other, specifically concerning utterances with topicalization. For example, P, A-E was analyzed as its own separate word order; however, the same word order could also be analyzed as A-E-P with the patient topicalized. Homesigner 05 (whose most common word orders are P, A-E and A-E-P) may actually be more internally consistent since those word orders are related. However, because it is unclear whether homesigners are using topicalization in these instances, I have chosen to classify them as distinct.

Table 6. Word orders produced most often by homesigners, based on their initial response to the stimulus item. P stands for patient, A for agent, E for action. Commas (e.g., P, A-E) indicate a pause between signs. Asterisks note that there is a tie for the most and second-most common order. Homesigners 19 and 21 have been grayed out because they did not produce enough multi-element utterances to be entered into the word order analysis.

Homesigner	most common order		second most common order	
02	P, A-E	33% (6)	A-P-E	28% (5)
05	P, A-E	44% (8)	A-E-P	22% (4)
17	P-A-E*	33% (6)	A-P-E*	33% (6)
18	A-P-E	50% (9)	P-A-E	28% (5)
19	A-E*	22% (4)	E*	22% (4)
20	P-E-A	22% (4)	P-A-E	11% (2)
21	E	44% (8)	P	11% (2)
22	P-A-E	56% (10)	A-P-E	22% (4)

Next, I looked at all productions (initial and subsequent) to see whether each homesigner exhibited a word order preference (Table 7). Unsurprisingly, the variation in word orders increased greatly because of the inclusion of subsequent productions, as homesigners may have altered or adapted their signing as a result of their communication partner getting the answer incorrect or requesting more information. Three homesigners (02, 05, and 22) remained relatively consistent. Homesigner 17 showed more of a preference for P-A-E (compared to A-P-E) when considering subsequent as well as initial responses. Relatedly, Homesigner 18 produced more P-A-E constructions in subsequent utterances compared to initial utterances, but this is probably due to the fact that Homesigner 17 was his communication partner and thus influenced his subsequent utterance ordering.

Table 7. Word order preferences for homesigners considering both initial and subsequent productions. P stands for patient, A for agent, E for action. Commas (e.g., P, A-E) indicate a pause between signs.

Homesigner	# of utterances	most common order		second most common order	
02	43	P, A-E	8 (19%)	A-P-E / A-E-P	6 (14%) / 6 (14%)
05	34	P, A-E	10 (29%)	A-E-P	8 (24%)
17	32	P-A-E	11 (34%)	A-P-E	6 (19%)
18	25	A-P-E	9 (36%)	P-A-E	8 (32%)
19	37	A-P	10 (27%)	E	9 (24%)
20	44	A-P-E	5 (11%)	P-A-E / P-E-A	4 (9%) / 4 (9%)
21	32	E	10 (31%)	A-E	6 (19%)
22	31	P-A-E	17 (55%)	A-P-E / P, A-E	4 (13%) / 4 (13%)

On a final note about word order, every homesigner except one (Homesigner 19) produced a "sandwich" at least once, in which they would alternate and repeat elements (e.g., action-agent-action). While no one used this construction frequently enough to be included as a most common or second-most common order, it is important to clarify that we did observe them and did not collapse them into another category (e.g., P-A-E is different from P-[E-A-E]). We counted a total of 36 sandwich constructions across 278 utterances. Half (n=18) of the sandwich constructions were produced in initial utterances. The most common type was action-agent-action (67%) and the next was action-patient-action (19%). For the action-agent-action sandwiches, a majority of those constructions (84%) used agent-focused actions to sandwich agents (e.g., KICK CHEF KICK as opposed to GET-KICKED CHEF GET-KICKED (patient-focused action)). Use of sandwich constructions did not improve CP comprehension.

While there does seem to be some tendency for homesigners to produce the patient before the agent (with the exception of Homesigner 18, who produced agent-initial utterances 67% of

the time), none of the homesigners had a consistent word order. However, word order is not the only strategy available to distinguish agents and patients.

Use of Space

Throughout the task, I observed five spatial strategies (Figure 11). Almost all of the movements in the action signs were in neutral space or on the body, so movement axes, such as the horizontal X-axis (from one side to the other, parallel with the front of the body), the sagittal Z-axis (from the body to straight outward or from directly in front towards the body), or the diagonal X+Z axis (Padden, Meir, Aronoff & Sandler, 2010), were not analyzed. The following spatial strategies were:

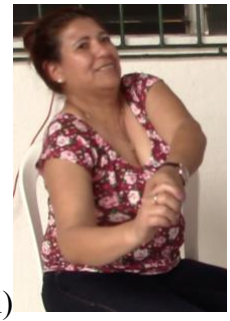
(i) *signer adopts patient role*: the signer represents the patient and acts on their own body (e.g., pulling their own arm)

(ii) *signer assigns experimenter to patient role*: the signer represents the agent and acts on the experimenter (e.g., tapping the experimenter)

(iii) *unidentified space/locus*: the signer references a locus but does not explain what it means or what it refers to (e.g., pointing to a spot but not indicating who or what that point is associated with)

(iv) *meaningful space/locus:* (context-dependent), the signer references a locus and a referent can be identified (i.e., meaning can be derived) if watching the stimulus video (e.g., signing SOLDIER then pointing behind themself; the stimulus video shows the soldier standing behind the other character)

(v) *body angle shift*: the signer changes the angle of their body when referring to a different character (e.g., sitting up straight and pointing to themself, then shifting body over and signing BRIDE to indicate a different character)

(i)  (ii)  (iii) 

(iv)  (v) 

Figure 11. Examples of the five spatial strategies we observed in homesigners' productions. (i) *signer adopts patient role*: signer's body represents the patient and acts upon it; (ii) *signer assigns experimenter to patient role*: signer represents the agent and acts on the experimenter; (iii) *unidentified space/locus*: signer references a locus but does not explain what it means or what it refers to; (iv) *meaningful space/locus* (context-dependent): signer references a locus but the referent can be identified if one watched the stimulus video; and (v) *body angle shift*: signer changes the angle of their body when referring to a different character.

Six of the eight homesigners used one of these spatial strategies at least once, but use of space grammatically varied (Figure 12). The two homesigners who did not use any spatial strategies were the same ones who rarely/never produced 3-element utterances and mainly produced nouns in isolation (produced very few modifiers). The most common strategy was *signer adopts patient role*; this was always done during actions (e.g., PUNCH in neutral space vs. GET-PUNCHED on arm). The *unidentified space/locus* strategy was more common than the *meaningful space/locus* strategy (context-dependent), indicating that homesigners may be starting to use space grammatically, but are still in early stages and thus are not always clear in what the space they are using actually means or what it refers to. Perhaps it is clear in the

homesigners' mind, but others are unable to tell. Homesigners seem to be distinguishing but not identifying arguments when using spatial strategies.

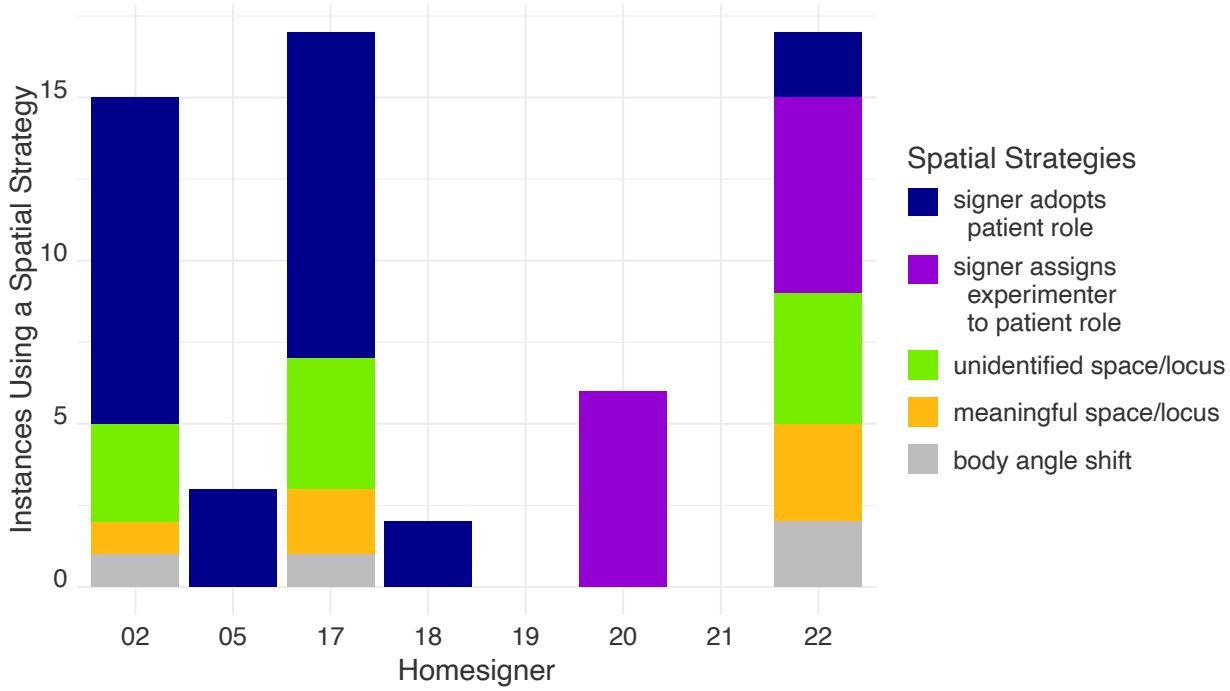


Figure 12. Spatial strategies used by homesigners. Note: two homesigners did not produce any spatial strategies.

The next question is, does the use of spatial strategies improve communication partners' comprehension? In fact, it did not. Communication partners were not more likely to respond correctly after homesigners used a spatial strategy (Figure 13). A chi-squared test indicated that there was no significant difference in correct responses when homesigners used space (23% correct) versus when they did not (30% correct) ($X^2(1, N = 168) = 0.71$, $p = 0.4$). Additionally, communication partners' hearing status did not affect their comprehension of spatial strategies. Deaf communication partners were no more likely than hearing communication partners to respond correctly when homesigners used a spatial strategy compared to when they did not. However, it is interesting to note that all four of the homesigners who had deaf CPs used spatial

strategies. In contrast, of the participants with hearing CPs, only the two homesigners who have participated in previous research used spatial strategies. The two homesigners who did not use any spatial strategies in this task were the only newly recruited participants who had hearing communication partners. Regardless, it seems as though homesigners are inclined to use spatial strategies, but in such early stages of language development, they neither help nor hinder comprehension.

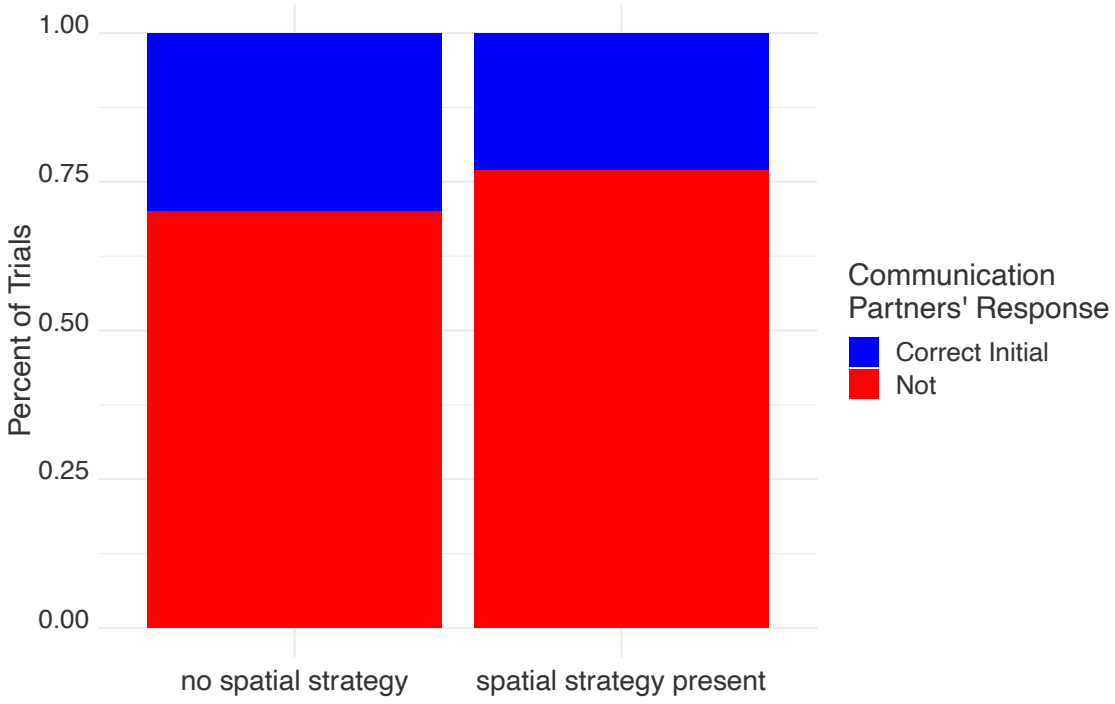


Figure 13. Communication partners' rate of correct responses did not differ based on whether homesigners used spatial strategies.

Other Devices

Action Type. Overall, a majority of action signs were agent-focused (80% e.g., TICKLE) compared to patient-focused (20% e.g., GET-TICKLED). Use of patient-focused actions varied amongst homesigners; the lowest (0%) was Homesigner 20 and the highest (39%) was

Homesigner 17. Because patient-focused actions were produced so much less frequently, it is hard to observe any pattern as to whether patient-focused actions are produced in combination with patient signs. There also seems to be a trend for patient-focused actions to coincide with the spatial strategy *signer adopts the patient role*. For example, Homesigner 17 adopted the patient role while producing a patient-focused action sign 70% of the time he produced a patient-focused action. However, there is not enough data to draw any major conclusions.

Paired Verbs. This type of sentence construction, in which two verbs are paired with nouns (e.g., N_1 V_1 N_2 V_2 or MAN PUSH WOMAN FALL) has been observed in LSN. Senghas and colleagues (1997) reported that in animate two-argument transitive events, paired verb constructions were common in Cohort 1 signers but not as common in later cohorts. In contrast, Flaherty (2014) found that paired verb constructions were produced to a similar degree across all three cohorts. Kocab and Snedker (in prep) found that paired verb constructions were most common in Cohort 2 signers. In the current study, I observed 5 homesigners use paired verb constructions (Table 8). The most common paired verb construction (48%; N=11) was Patient Agent $Verb_1$ $Verb_2$ ($Verb_1$) (e.g., CLOWN BRIDE HUG BE-HUGGED (HUG)). A similar type of pairing construction involving producing the nouns first and then the verbs (N_1 N_2 V_1 V_2) has been observed in Cohort 2 LSN signers, but not Cohort 1, in low frequency for two-argument reversible transitive events only, but this specific construction (N_2 N_1 V_1 V_2) was not observed (Senghas et al., 1997). The typical N_1 V_1 N_2 V_2 construction was only produced by one homesigner only once. Paired verb constructions were split fairly evenly between agent-initial utterances (n=10) and patient-initial utterances (n=13). Use of paired verbs did not improve communication partners' comprehension.

Table 8. Paired verb constructions produced by homesigners. Percentages are calculated based on initial utterances with at least 2 elements (1-element utterances were excluded).

Homesigner	Paired Verbs
02	7 (39%)
05	3 (17%)
17	8 (44%)
18	3 (17%)
19	–
20	–
21	–
22	2 (11%)
TOTAL	23 (16%)

POSE Hold. In the POSE hold device, the signer would hold their arms straight down at their sides with a straight back and hold the pose for a brief moment (Figure 14). I observed 33 instances of this POSE hold produced by four homesigners, with Homesigner 05 producing 58% of them. I found that 95% of POSE holds were produced in conjunction with a sign for the patient. In fact, 85% of POSE holds were produced directly after the sign for the patient. This suggests that POSE hold may function as a patient marker. Similarly, Coppola (2002) observed homesigners using what she referred to as “patient-pose” (pp. 41) which were included in groupings of multiple signs referring to the patient, such as (patient-pose) patient patient-pose. Use of POSE hold did not improve communication partners' comprehension.

Figure 14. Example of a POSE hold (arms straight down, back straight, brief pause in this position). POSE holds frequently occurred in conjunction with a patient sign.

Summary and Discussion

There was a great deal of variation in homesigners' patterns of productions. In terms of word ordering patterns, action-final utterances were most common. Action-final utterances are also common in LSN. Flaherty (2014) found that 99.5% of utterances produced by LSN signers with at least one noun and one verb (802 out of 806 utterances) were action-final. Similarly, Kocab & Snedeker (in prep) found that LSN signers produced action-final utterances 94% of the time. Some homesigners produced more patient-initial utterances, while two produced more agent-initial utterances. In general, homesigners did not have consistent internal word orders; the homesigner with the most consistent word order still only produced that order on 10 of the 18 initial utterances and on 55% of all utterances. It is possible that word ordering may have been influenced by external factors, given that when the patient was on the left side of the video, participants were more likely to produce a patient-initial utterance, although there was no effect on ordering based on the position of the agent in the stimulus video. There may also be other factors influencing the word ordering that we have not yet considered or looked into. Consider,

for example, Homesigner 17, who produced patient-agent-action (P-A-E) and agent-patient-action (A-P-E) utterances at equal rates. Currently, it is not clear why he would swap agents and patients in his word order that often. Alternatively, if homesigners are not using word order as a meaningful strategy, perhaps the word orders are somewhat random or influenced by external factors like the video, characters, previous experience, or communication partners' reactions.

It does not seem that homesigners use word order systematically to distinguish agents and patients; however, that is not the only potential strategy available to them. I observed a majority of homesigners using spatial strategies. Critically, the use of space was still in early stages of development and systemization, so in most cases, they did not always identify which character was associated with the use of space on the action sign, and it would be difficult to derive meaning without more context. In fact, communication partners were no more likely to select the correct answer after a homesigner produced an utterance using a spatial strategy than an utterance without the use of space. This suggests that either communication partners are not sensitive to spatial strategies, or that homesigners' use of space is still developing as a strategy and is not conventionalized and easily understood.

Finally, I observed three other potential argument marking strategies. Homesigners produced mostly active action types (e.g., HIT) over passive action types (e.g., GET-HIT), but I did not observe any association between agents coinciding with active actions or patients coinciding with passive actions. In contrast, the POSE hold used by four homesigners was reliably produced in conjunction with the patient, suggesting that this strategy is an emerging patient marker. I also observed five homesigners using paired verb constructions, which is also seen in LSN. However, none of these other devices were associated with communication partners' comprehension of the utterance.

Study 2b: Nonlinguistic Representation of Agents and Patients

Do homesigners have nonlinguistic representations of agents and patients?

The results of Study 2a were somewhat inconclusive. It is unclear from the data whether homesigners have separate concepts for agents and patients since we cannot tell how they are distinguishing them. However, just because we cannot identify a way that homesigners are contrasting agents and patients does not mean that they do not possess separate concepts for these roles. Instead, the fault may be with the task or analysis itself. Perhaps homesigners are distinguishing agents and patients in a unique way that we as researchers do not notice. Carrigan and Coppola's (2017) comparison of homesigners' mothers' comprehension and ASL signers' comprehension of homesigners' descriptions of two-argument reversible transitive events found that two ASL signers had better comprehension than the mothers, but in the other two cases, ASL signers' and mothers' comprehension was virtually identical (see also Carrigan, 2012).[3] At this time, it is unclear whether homesigners reliably distinguish between agents and patients in a way that others, who either have experience interacting with the homesigner on a daily basis or have experience using a visual-manual language and are sensitive to grammatical aspects in that modality. Or perhaps, homesigners possess distinct concepts of agent and patient but lack the ability to express them linguistically. Therefore, this next study focuses on nonlinguistic representation of agent and patient using eye tracking methodology.

Truly nonlinguistic concepts of agents and patient are difficult to measure since previous studies either focus on infants being sensitive to causal relationships and switching agent/patient

[3] Across all event types (one- and two-argument, intransitive and transitive, non-reversible and reversible), Deaf ASL signers had better comprehension than the homesigners' hearing mothers in three out of four cases (homesigners' descriptions of vignettes were recorded and then the videos were shown to their mothers and one Deaf ASL signer per homesigner). When just analyzing two-argument reversible transitive event descriptions, only two ASL signers outperformed homesigners' mothers.

roles (Leslie & Keeble, 1987; Golinkoff, 1975; Golinkoff & Kerr, 1978; Saxe, Tenenbaum & Carey, 2005) or adults who could be potentially be using language even if the task does not require it (e.g., Hafri, Papafragou & Trueswell, 2013). Previous research suggests that agent and patient concepts may exist outside of language. However, one recent study using eye tracking as a methodology provides evidence for the contrary. Shukla and de Villiers (2021) showed participants 2-argument reversible events and single-argument intransitive events in a learning paradigm in which the same agent/patient combination would turn colorful and the video would play again. Participants who engaged their agent/patient concepts would ideally learn the pattern and anticipatorily gaze toward the video they expected to play again (referred to as the anticipatory effect). In order to assess the role of language, the researchers compared performance of adults (who had typical access to language) to adults engaged in a verbal shadowing exercise (i.e., listening to an audiobook and repeating what they heard), which effectively prevented them from using language during the task. They also tested typically developing infants who were in the process of acquiring language. All participants showed the anticipatory effect on single-argument intransitive events. However, only typical adults showed the anticipatory effect when viewing reversible two-argument reversible events; adults engaged in verbal shadowing and infants did not. Since participants who did not have full language abilities (either because it was temporarily blocked or because they were in the process of acquiring language), these results suggest that language may play a role in agent/patient concepts.

In the following study, I expand upon Shukla and de Villiers' (2021) findings, focusing on homesigners, a population that does not have full access to language, in order to assess nonlinguistic agent/patient concepts. If my results align with Shukla and de Villiers's (2021)

findings, we would see that homesigners would not show the anticipatory effect, suggesting that language is necessary. However, if they do, perhaps that means that they do have and use these nonlinguistic concepts.

Participants

Eight homesigners (4 female, 4 male) participated in this task (conducted in January 2024). Three were experienced and five had been newly recruited the previous year. For more details about the participants, see Chapter 2.

Procedure

The nonlinguistic agent-patient task was adapted from an eye tracking study designed by Shukla and de Villiers (2021). In the current study, this task was always run in the middle of the session to allow participants to become comfortable with the experimenters but before their energy levels waned.

In this task, on each trial participants were shown two grayscale animations of a car pushing a dog and a dog pushing a car, shown side by side on a computer screen (Figure 15). Each event looped twice and the videos played sequentially. Then the target agent/patient combination turned to full color and that video repeated again. We analyzed the anticipatory period of 2.5 seconds right after both grayscale videos have played but before the color (target) video is revealed.

Participants were randomly assigned to one agent/patient target (i.e., either "dog pushes car" or "car pushes dog") for the entire task. There were two versions of the stimuli: one in which the "dog pushes car" video always turns to color and one in which the "car pushes dog" video always turns to color. Participants passively watched the videos while their eye gaze movement information was recorded. There were two blocks with breaks in between.

Participants were directed to simply watch the screen and explicitly instructed not to sign anything while watching the videos.

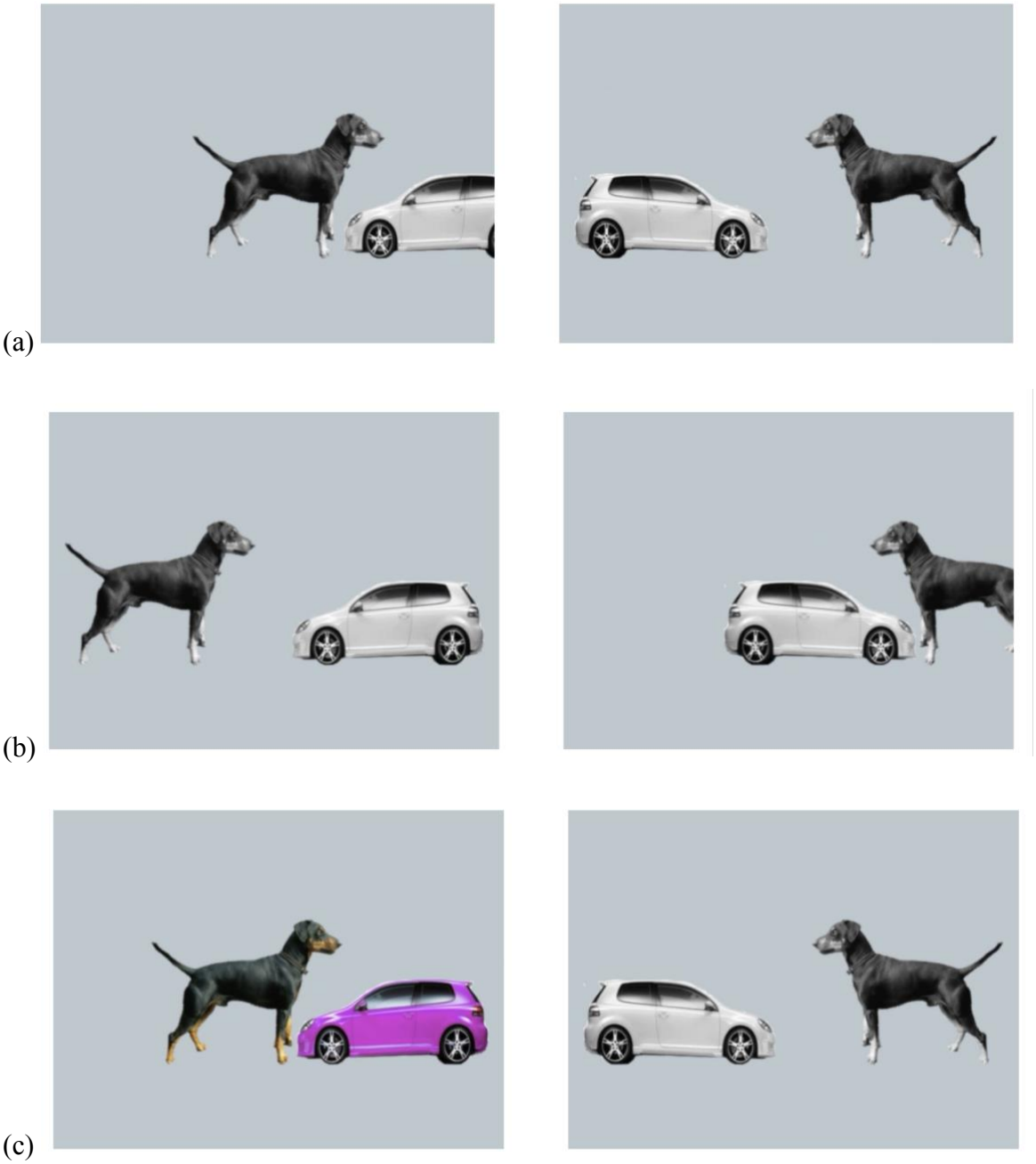


Figure 15. Training trial set up. First, (a) left grayscale video (dog pushes car) plays twice, then (b) right grayscale video (car pushes dog) plays twice. After 2.5 seconds, (c) the target agent/patient combination (dog pushes car) turns to full color and plays again. A video example from Shukla and de Villiers' (2021) original stimuli can be viewed at https://www.youtube.com/watch?v=Qwo3OsTyIiA.

There were 32 trials in total; the first 8 were training trials with the same car/dog and trials 9-32 were test trials and had new sets of cars and dogs on each trial. Each animation also included a little "hop" for both agent and patient before the actual event to reduce the chance that participants were just looking for the entity that is moving first (e.g., perceptual information) instead of recognizing the agent by its role in the event. Each trial lasted 16 seconds, so the entire task took around 8.5 minutes. Each participant did the task twice (with a break in between) for a total of 64 trials (56 test trials + 8 training trials). Participants always watched the same version of the stimuli (i.e., "dog pushes car") for both rounds of the task so they did not need training trials the second time. I used a logistic webcam mounted to a laptop screen and Open Broadcaster Software (OBS) for video and screen capture.

Coding and Analyses

Eye gaze was coded after the fact, from screen recordings of the stimuli and video recording of the eye movements from the webcam, using ELAN to annotate and timestamp eye gaze direction during the anticipatory period. Following the analysis plan of Shukla and de Villiers (2021), in coding the eye tracking, I ignored the y-axis (vertical) and only coded x-axis (right versus left side of the screen). Analysis of eye gaze was restricted to the anticipatory period (2.5 seconds between the last frame when the + appears and the last frame before the target video turns to color and plays again). For the anticipatory period (AP) on each trial, I coded the duration of time participants spent looking left, right, or away from the screen, using ELAN to annotate time stamps and duration of gaze direction.

For each trial, I calculated the proportion of time spent looking in each direction. Anticipatory periods with a higher proportion of gazes to the left were coded as -1, and anticipatory periods with higher proportion of gazes to the right were coded as +1. If the highest

proportion of time during the trial was spent looking away from the screen, that trial was excluded from the analysis. Overall, 45 trials (10%) were excluded due to artifacts (e.g., blinking, looking away, falling asleep). Additionally, I did not include the training trials (8 per participant, 64 total) in the final analysis. This left me with 403 test trials total.

For each participant, I calculated the mean gaze location along the x-axis during the anticipatory period for trials when the target was on the left and for trials when the target was on the right. Gazes to the left side were coded as -1 and the right side as +1. Therefore, more left side gazes would result in a negative number while more right side gazes would result in a positive number. Shukla and de Villiers (2021) specifically included whether the target was on the left or right side in their analysis because the videos always played in a specific order (right, then left) which may have biased participants towards a certain side. Therefore, I used their methods to calculate mean eye gaze based on target location, and included participants as random effects. I used the linear mixed effects regression model: lmer(MeanGaze ~ TargetLocation + (1 | ParticipantID)). If participants picked up the pattern (based on an understanding of agent and patient roles), they would show an anticipatory effect, having a negative mean gaze value when the target was on the left and a positive mean gaze value when the target was on the right. Finally, for each participant, I also calculated the proportion of trials on which they looked to the target side, regardless of which side of the screen it was on.

Results

Group Observations

Overall, the average number of trials in which participants looked a majority of the time to the target side during the anticipatory period was 48%. A chi-squared test indicates that there was no significant difference between anticipatory looks to the target versus at the other side (X^2

(1, N = 403) = 0.419, p = 0.51). Participants were performing at the level of performance expected by chance (50%), indicating that in general, they were not picking up on the pattern. Indeed, a linear mixed effects model with target location as a fixed effect and participant ID as a random effect also found that target location did not significantly predict anticipatory eye gaze direction (t = -0.55, p > 0.05) (Table 9).

Comparing this model to the null model (i.e., MeanGaze ~ 1 + (1 | ID)) using ANOVA revealed no significant difference between models (p > 0.05) indicating that inclusion of the target location did not improve model fit. Additionally, adding the stimulus version (e.g., dog as agent vs. car as agent) did not improve model fit. It seems as though as a group, homesigners do not show an anticipatory effect by looking towards the side of the screen where the target will appear.

Table 9. Results from linear mixed effects model <- lmer(MeanGaze ~ TargetLocation + (1|ID))

	AP Gaze (right) β (SE)
Target Location (right)	-0.073 (0.132)
Intercept	0.008 (0.131)
Observations	16
*Note: *p<0.05; **p<0.01*	

Random Effects	Variance	SD
Participant ID	0.07	0.26
Residual	0.07	0.26
Observations: 16	*Groups: 8*	

I also compared performance on Block 1 versus Block 2 to investigate any practice effects or attention issues. A chi-squared test found no significant difference between gazes to target versus gazes in the opposite direction on Blocks 1 and 2 (X^2 (1, N = 403) = 1.389, p = 0.2). Chi-squared tests also found no significant difference in performance between the first and second halves of block 1 (X^2 (1, N = 178) = 0.57, p = 0.4), the first and second halves of block 2 (X^2 (1, N = 403) = 1.3, p = 0.4), or the first halves of both blocks and the second halves of both blocks (X^2 (1, N = 225) = 0.75, p = 0.2). Overall, there does not appear to be any significant practice or fatigue effects.

Individual Observations

Since we did not find an overall trend, we decided to look at participants individually. This is particularly important for homesigners because their experiences are so varied and they are not a cohesive group, so averaging across participants may obscure findings.

When I looked at participants separately, I found that one homesigner (20) performed above the level of performance expected by chance (correct gaze direction on 69% of trials), but the other seven participants performed at chance and appeared to be looking randomly (Figure 16). Analysis of mean gaze direction versus target side corroborated these findings. Again, only one participant (Homesigner 20) showed an anticipatory effect, exhibiting a negative mean gaze value when the target was on the left and a positive mean gaze value when the target was on the right (Figure 17). A t-test revealed a significant difference between mean gaze value when target was on the left (M = -0.57, SD = 0.835) compared to mean gaze when target was on the right (M = 0.19, SD = 1.00) just for Homesigner 20 ($t(53)=2.98$, $p < 0.01$). While some participants appeared to be trending in the reverse direction with positive left side values and negative right side values (e.g., Homesigners 02 and 18), the difference was not significant.

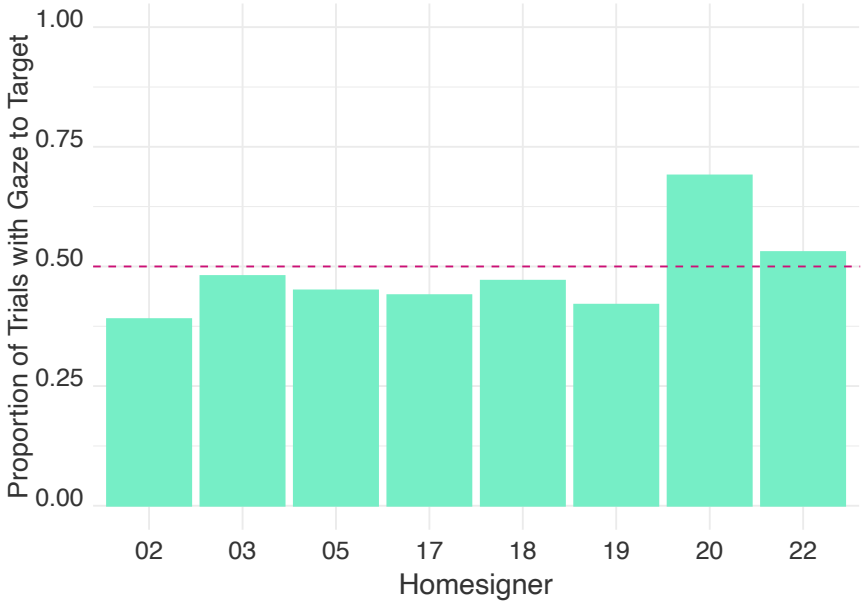


Figure 16. Proportion of trials with a majority of the gaze duration to the target side. Only one participant (Homesigner 20) performed above the level of performance expected by chance (red dotted line, 50%).

Figure 17. Individual results for mean gaze during the anticipatory period (AP) based on the target side. One participant (Homesigner 20, pink line) showed the anticipatory effect (negative value when the target appeared on the left, positive value when the target appeared on the right). The average mean AP gaze is in red. The gray dotted line at 0 represents no gaze preference to the left or right.

Next, I wanted to see if individuals had a general looking preference. Since the target video was randomized and appeared on each side of the screen equally, we should expect to see no difference between left and right gazes, each hovering around 50%. However, this was only the case for four of the participants (Appendix D, Figure 18). Two homesigners showed a preference for the right side (Homesigners 18 and 19) and two homesigners showed a preference for the left side (Homesigners 03 and 22).

Next, I analyzed performance on the two blocks individually to check for individual practice or fatigue effects. When separating performance on Blocks 1 and 2, three homesigners performed above the level of performance expected by chance on at least one block: Homesigner 18 on block 1, Homesigner 22 on block 2, and Homesigner 20 on both (Appendix D, Figure 19). Overall, 4 participants seemed to perform better on Block 1 than Block 2. In fact, it seems as though some participants (e.g., Homesigner 02, 05, 18, and 19) were actually performing well below chance, particularly on Block 2, suggesting that they were looking in the wrong direction on a majority of trials in Block 2.

Then I compared individual performance on the first half of both blocks with performance on the second half of both blocks. Four homesigners performed above the level of performance expected by chance on at least one half of both blocks: Homesigner 03 on the second half, Homesigners 18 and 22 on the first half, and Homesigner 20 on both (Appendix D, Figure 20). Overall, 4 participants seemed to perform better on the first halves of the blocks compared to the second halves. However, again, several participants performed well below chance, looking in the wrong direction more often than not.

Finally, I compared performance by separating blocks 1 and 2, and separating each block into first half and second half. While there was a great deal of variation, here, we see that six

homesigners performed above the level of performance expected by chance on at least one half of one block: Homesigners 02 and 18 on the first half of block 1, Homesigner 05 on the second half of block 1, Homesigner 22 on the first half of block 2, Homesigner 03 on the second halves of both blocks, and Homesigner 20 on all (Appendix D, Figure 21). Some participants exhibited fatigue effects (e.g., Homesigners 18 and 20), some showed practice effects (e.g., Homesigner 03), but it is difficult to draw conclusions about this variation.

Summary and Discussion

Overall, I did not find an anticipatory effect for homesigners as a group. As a whole, participants performed at the level of performance expected by chance for gaze direction, suggesting that they did not learn the pattern, which was purportedly based on an understanding of agent and patient roles. On an individual level, one homesigner (20) did show an anticipatory effect. However, it is unclear why only this one person showed an anticipatory effect. In fact, Homesigner 20's experience is quite similar to Homesigner 22's (i.e., both of them are in their sixties, have a relative who knows LSN but never learned it themselves, and work as seamstresses), but Homesigner 22 did not show an anticipatory effect. Two homesigners (02 and 17) seemed to show a reverse trend, looking in the opposite direction as the target during the anticipatory period, but neither reached significance.

When breaking up the analysis into blocks and halves of blocks, more homesigners appear to perform above the level of performance expected by chance at least during part of the task. However, practice and fatigue effects were not consistent. When comparing performance by blocks, three homesigners performed above chance on at least one block, but there was no overall difference in performance on specific blocks. When comparing first half and second half performance, four homesigners performed above chance on at least one half, but it varied on

which half. Finally, when separating the task into four parts (first half block 1, second half block 1, first half block 2, second half block 2), six homesigners performed above chance on at least one of the four parts. However, performance across parts varied and it is difficult to determine whether practice effects or fatigue effects were common.

Discussion

In both linguistic and nonlinguistic studies, I did not find extensive evidence of homesigners possessing agent and patient concepts. With regard to the linguistic task, I did not observe homesigners using common systematic methods (e.g., word order, spatial strategies) to distinguish agents and patients. Interestingly, many homesigners used preliminary spatial strategies, but they usually were not successful in communicating who was the agent and who was the patient to their communication partner. Additionally, while a few homesigners appeared to produce what could be a preliminary patient marker (POSE hold), it was not frequent or widespread among participants. Study 2a provides some evidence that language may be necessary to form separate concepts of agent and patient; however, it is possible that homesigners do in fact possess distinct agent and patient concepts, but lack the ability to linguistically express it in a way that we can observe. This led us to run a new task to see if we could capture homesigners' nonlinguistic concepts of agent and patient.

In terms of the nonlinguistic task, overall homesigners performed at levels that would be expected by chance, suggesting that they were not learning where to look during the anticipatory period by drawing on their knowledge of agent and patient categorization. In fact, only one homesigner individually showed this anticipatory effect, indicating that during the practice trials she learned that (in her case) the video with a dog as the agent would always turn colorful and play again and looked accordingly. When breaking down performance into halves and blocks,

there appeared to be some practice or fatigue effects for many participants, but performance was incredibly variable. Study 2b also provides more evidence that language may be necessary to develop the concepts of agent and patient.

Taken together, linguistic and nonlinguistic evidence suggest that language may actually be a critical factor in the development of agent and patient concepts. This is contrary to the theory that thematic roles are universal underlying concepts (Rissman & Majid, 2019). However, while many studies have found evidence for this theory, none have investigated thematic role concepts in adults who have had little to no outside linguistic input. There is a big difference in language experience and brain processing between an infant who has been exposed to language from birth but has not yet fully acquired language and an adult who has not had full access to an existing language and instead creates their own to communicate with others. Therefore, these findings may not necessarily be in direct contrast to the universal underlying concepts theory, but rather shedding new light on how language experience (particularly having limited to no exposure to an existing language) might impact the development of such concepts. The implications of this will be discussed more in Chapter 5.

Although the sample sizes of homesigners in these studies are small, these findings can provide unique insight into how language influences the development of agent and patient concepts, especially when we compare homesigners' performance to that of adults with typical language experience. Kocab and Snedeker (in prep) used the same stimuli from the Event Pragmatic Task with 30 deaf Nicaraguan LSN signers and found that they also did not produce a consistent word order, but, unlike with the homesigners and communication partners, the comprehenders (another deaf LSN signer) were still responding correctly, well above the level of performance expected by chance. Comprehension was high with LSN signers because they were

often using spatial marking (e.g., assigning an agent locus and a patient locus, plus using directional verbs that started at the agent locus and moved to the patient locus). Given that many homesigners used space but often not in a transparent way (e.g., rarely using space coreferentially, not assigning meaning to a locus, leaving the meaning unclear without having the context of the video), spatial marking as a strategy may need a linguistic community in order to develop and be used. Kocab and Snedeker (in prep) also found patient markers, similar to the one described here, mostly in early cohort LSN signers, suggesting that the POSE hold may be a preliminary way to denote patients, but as a language conventionalizes, becomes less efficient and replaced with more efficient strategies.

We can also compare our eye tracking results with homesigners to Shukla and de Villiers' (2021) eye tracking results with typical adults and infants since we used the same stimuli. They found that typical adults showed the anticipatory effect for 2-argument reversible transitive events, but infants did not. However, when adults had to perform verbal shadowing while watching the stimuli (i.e., listening to an audiobook and repeating what they heard, effectively preventing them from using language), they also did not show an anticipatory effect. Our results with homesigners not showing an anticipatory effect seem to align with Shukla and de Villiers' (2021) results. Specifically, when access to language is blocked in a variety of ways (e.g., verbal shadowing preventing concurrent use of linguistic abilities, participants who have been exposed to language but not yet acquired it, participants with limited to no language exposure), participants cannot use any extant knowledge of agents and patients to inform their anticipatory looking. Critically, it must be noted that the effect in adults that Shukla and de Villiers' (2021) found was driven by the 'dog as agent' condition. Participants in the 'dog as agent' condition showed a significant anticipatory effect, whereas participants in the 'car as

agent' condition did not. It should not come as a surprise then that Homesigner 20, the only homesigner who showed this anticipatory effect, was in the 'dog as agent' condition. However, even when analyzing participants from the 'dog as agent' condition, Shukla and de Villiers (2021) found only very small effect sizes. If typical adults with full access to language only showed a weak anticipatory effect in one of the conditions, then perhaps it is not surprising to not find any anticipatory effect with other participants, such as homesigners in our study.

To our knowledge, Study 2b is the first published study using eye tracking as a methodology with homesigners. It was very much a learning experience since there was no previous work to refer to. While I will discuss this further in Chapter 5, I can say that we were successful in conducting an eye tracking study in the field with homesigners. Unfamiliarity with technology and limited attention spans were two major issues, but we still were able to get usable data. In order to further demonstrate proof of concept that eye tracking works with homesigners, I suggest using similar set-up and stimuli (also from Shukla and de Villiers' (2021) study), and having homesigners watch the 1-argument intransitive events (e.g., dog rolling, car rolling), in which both infants and verbal shadowing adults showed an anticipatory effect. If homesigners show an anticipatory effect on 1-argument but not 2-argument events, this would align with their findings that language may be necessary to represent agents and patients (two-argument events) but not single-argument events. However, if homesigners do not show an anticipatory effect with 1-argument events, this would suggest that something else may be going on, and perhaps the task would need to be modified for homesigners.

Chapter 5. General Discussion

Summary of Results

This dissertation investigated how language impacts the pragmatic knowledge and concepts of agent and patient of adult homesigners who have experienced minimal to no outside linguistic input, especially early in development. First, I investigated whether homesigners would utilize pragmatic knowledge and provide the relevant information in descriptions of objects (nouns/modifiers) and events (actions/agents/patients) using novel referential communication tasks. Homesigners did use pragmatic understanding and produced relevant information, but it was not consistent, even with the new methodology designed to encourage homesigners to produce the relevant information. Specifically for nouns and modifiers, homesigners were more likely to produce modifiers on trials with a distractor (i.e., when pragmatically necessary to include modifiers). Additionally, homesigners engaged in other-initiated repair (as seen in Safar & de Vos, 2022), by producing modifiers more often on subsequent responses when it was clear that the communication partner did not know the correct answer. In terms of event representation, most homesigners produced agents, patients, and actions on most trials (6 out of 8 produced all three elements on at least 50% of trials).

However, communication partner comprehension was a great deal lower on the Event Pragmatics Task than on the Noun-Modifier Pragmatics Task. One main reason is that on the Event Task, simply providing the action and two characters is not enough; homesigners must also differentiate between the agent and patient, communicating who is doing what to whom. Upon investigating different strategies, I did not find consistent word orders for homesigners, but I did find preliminary use of spatial strategies. However, neither word order nor the use of spatial strategies affected communication partners' comprehension. These strategies are likely still

burgeoning and are not yet conventionalized, potentially because conventionalization is much slower in homesign systems than in emerging sign languages due to the presence or lack of a primary linguistic community (Richie, Yang & Coppola, 2014; Quam, Brentari & Coppola, 2022). Some homesigners also used other devices, such as paired verbs and patient markers, although use of these devices also did not improve communication partners' comprehension. Of the three participants who used spatial strategies, paired verbs, and patient markers all at least once, two were experienced participants (Homesigners 02 and 05) and only one (Homesigner 17) was a newly recruited participant. The results from the linguistic event representation task do not provide evidence that homesigners are systematically differentiating agents and patients in their productions.

Another possibility is that homesigners possess the concepts of agent and patient but lack the ability to overtly mark them linguistically. Finally, I used a nonlinguistic eye tracking paradigm to detect evidence of the concepts of agent and patient in homesigners without explicitly needing to use language. The eye tracking results revealed that overall, homesigners were not using knowledge of agent and patient to guide their anticipatory looking. Only one participant showed an anticipatory effect; everyone else's looking behavior (towards the expected target or not) was at the level of performance expected by chance. The overall eye tracking results align with Shukla and de Villiers' (2021) findings that anticipatory looking based on agent-patient knowledge does not occur when access to language is impeded, either through verbal shadowing preventing current use of linguistic abilities (adults in their verbal shadowing condition), participants who have been exposed to language but not yet acquired it (infants), or, as seen in the current study, participants with limited to no language exposure (homesigners).

Results are summarized in Table 10. Overall, I found evidence for homesigners using

pragmatic understanding to produce relevant information for their communication partners. By employing novel referential communication tasks, we successfully encouraged homesigners to produce more modifiers than found in previous studies on homesigner noun-modifier productions (Do et al., under review) and more 2-argument utterances than found in previous studies on homesigner event representation (Flaherty, 2014; Coppola, 2002). While I did not find evidence that homesigners distinguish agents and patients, linguistically or nonlinguistically, I hesitate to draw sweeping conclusions from this lack of evidence. It is possible that homesigners do possess the concepts of agent and patient, but researchers have yet to develop methodologies that can measure it and/or homesigners are using strategies that communication partners are not sensitive to.

Table 10. Summary of research questions and findings.

1. Do homesigners show pragmatic understanding by producing all necessary information?	With nouns and modifiers	Yes, most homesigners
	With agents, patients, actions	Often, most homesigners
2. Do homesigners have concepts for and distinguish between agents and patients?	Linguistic representation	No explicit distinction; preliminary strategies but nothing systematized
	Nonlinguistic representation	No overall; sometimes individually

How These Findings Fit With Current Literature

Several of these findings align with findings from other researchers. I found that homesigners in Nicaragua demonstrated pragmatic knowledge, similar to Safar and de Vos' (2022) findings with Balinese homesigners. Most homesigners in the current study used spatial strategies when describing events, similar to Coppola and So's (2006) findings, also with Nicaraguan homesigners (two homesigners participated in both studies). None of the

homesigners in the current study showed a strong word order preference, which aligns with Kocab and Snedeker's (in prep) work showing that Nicaraguan signers also do not have a conventional word order in LSN. Communication partners' poor comprehension rates on the Event Pragmatic Task is similar to Carrigan and Coppola's (2017) finding that hearing mothers' comprehension of homesigners' descriptions of events was low. Finally, the nonlinguistic eye tracking results, in which overall homesigners did not show the anticipated looking pattern based on agent-patient knowledge, aligns with Shukla and de Villiers' (2021) findings where individuals whose access to language was blocked (adults engaged in verbal shadowing or infants) did not show the anticipated looking pattern, but adults with typical language experience did.

Some of the current findings did not align with previous results, but many of the discrepancies can be attributed to differing methodology. For example, Do and colleagues (under review) reported that homesigners rarely produced modifiers (0 to 5 modifiers per person), but here I found that every homesigner produced at least some modifiers, with the lowest occurrence being 5 utterances including a modifier (16% of trials) and the highest occurrence being 27 utterances including a modifier (84% of trials). Importantly, the stimuli used in Do and colleagues' (under review) study was not designed to assess modifier usage (the original study by Abner et al. (2019) designed the stimuli to investigate the noun-verb distinction). This dramatic increase in modifier production is likely due to the use of the Noun-Modifier Pragmatic Task which encouraged homesigners to produce modifiers by creating contrasts between objects, requiring them to elaborate so that their communication partner could choose the correct item. Similarly, Flaherty (2014), using an elicitation task involving videos depicting simple events (including animate and inanimate arguments, and transitive, reversible and intransitive events),

found that homesigners rarely produced utterances with both arguments (i.e., agent and patient) and an action. Whereas most of the homesigners (6 out of 8) in the current study produced all three elements (agent, patient, action) in the same utterance on more than half of the trials. Again, this discrepancy is likely due to methodological differences; due to the contrastive nature of the design of the Event Pragmatic Task, participants were encouraged to produce all of the relevant information.

With regard to other studies finding regularities in word ordering with homesigners, this could also be attributed to differences in methodology. For example, Goldin-Meadow and Mylander (1998) reported ordering preferences based on naturalistic mother-child play observations involving two children who produced enough agents to analyze. When analyzing production probabilities among all 8 children (regardless of whether they produced enough arguments to analyze word ordering), they found that patients were more likely to be produced than agents. The current study did not find any differences between agent and patient production, which were produced at around the same rate, although actions were produced reliably more than patients. As our findings are with adults and based on elicited productions with generally more data points, these two studies cannot directly be compared. Nevertheless, they found that amongst all 8 children, patients were more likely to be produced. Coppola and Newport (2005) reported that homesigners placed Subjects at the beginning of clauses; these thematic roles included agents as well as patients, experiencers (i.e., of emotions), and themes (i.e., inanimate objects). Further, their analysis of word order focused on a target clause that excluded noun phrases that had been topicalized, or fronted, to the beginning of the utterance and set off prosodically. Thus these analyses are difficult to compare directly. However, in line with the previous findings, I did find that generally homesigners produced actions in the final position of

a utterance, meaning that they were more likely to produce arguments (either agents or patients) at the beginning of utterances.

Interpreting the Role of Language in Agent/Patient Concepts

One of the focuses on this dissertation was to address the extent to which language may be involved in the development of thematic role concepts. Many studies claim the existence of universal concepts of agent and patient apart from language (e.g., Rissman & Majid, 2019; Connor, Fisher & Roth, 2013; Strickland, 2017; Chang, Dell & Block, 2006; Hafri, Trueswell, & Strickland, 2018). However, none of these studies has actually looked at situations in which individuals have limited to no language exposure. Because language is so embedded in everything that we do, it can be very difficult to imagine what language and cognition would be like without exposure to a consistent language model. But for many homesigners, that is their reality. Outcomes observed and expected in typical development may not occur or perhaps may occur differently. Therefore, when looking at homesigners, it is possible that we might find drastically different outcomes than those found in the typical population. If research solely focuses on "typical" experiences, we might miss important things and draw narrower conclusions. Even when a considerable number of studies with typical populations are in consensus regarding the universal nature of certain underlying concepts, one study with participants who have unexpected experiences regarding their language experience may be able to offer insight into how language may be involved in the development of these concepts in a way that has not been previously considered.

However, it is important to note that just because we did not observe evidence of agent and patient concepts in these studies, does not necessarily mean that homesigners do not possess these concepts. It is possible that the methodology used to assess these concepts was not well-

suited for homesigners. For example, in the linguistic task (Event Pragmatics Task), I focused on word order and use of space, as those are two very common strategies for distinguishing agents and patients in sign languages (Sandler & Lillo-Martin, 2006). However, these are not the only possible strategies; a few homesigners appeared to use a preliminary patient marker (POSE hold) and paired verb constructions. There are likely other methods for distinguishing agents and patients that the current coding scheme did not capture.

Additionally, having a concept and being able to linguistically express said concepts are two separate things. Someone could understand a concept but not be able to express it linguistically. This also could relate to the lexical competence hypothesis (Hudson & Eigsti, 2003), in which the more competent a person is with their lexical knowledge (e.g., vocabulary size, ease of lexical access), the more grammatical/functional structure and complex sentence structures they use. Since homesigner's lexicons take a very long time to conventionalize (e.g., Richie et al., 2014), their lexical knowledge may not be as robust compared to someone with full access to language, which in turn could impact how they use grammatical structures. Homesigners may have some concept for agent and patient but may not have the lexical competence to produce grammatical distinctions between the two. For example, the degree of lexicalization may affect their ability to use consistent devices marking argument structure. Future work could assess the degree of lexicalization or consistency to see if there is a relationship between devices (paired verbs, patient marker) used and/or internal consistency for word orders and spatial devices. A lack of evidence for homesigners distinguishing agents and patients in Study 2a should not be taken as evidence that homesigners do not have separate concepts for agents and patients, but rather spur further research with new methodologies.

Similarly, while the nonlinguistic eye tracking task also did not find evidence for agent-patient distinction, this could be due to the task itself, not necessarily an indication of homesigners' nonlinguistic knowledge. Shukla and de Villiers' (2021) original study found a very small effect in typical adults, and only in one condition, so not finding an effect in a smaller sample may not be such a surprise. Finally, there may be some disconnect between the anticipatory eye gaze and agent-patient concepts. The task attempts to create a nonlinguistic assessment of agent-patient concepts, but because it is not explicit, we actually do not know if this task truly assesses knowledge of these concepts. Just because someone does not look to the expected side, does not mean that they definitely do not understand agents and patients. Taken together, the current studies (2a and 2b) do not provide positive evidence that homesigners conceptually distinguish agents and patients, but instead of taking these results at face value, it should prompt further investigation and new, more nuanced, methodologies.

Although homesigners did not reliably distinguish between agents and patients on the Event Pragmatics Task, they did use a variety of strategies (use of space, patient markers, paired verbs). While none of these strategies were used consistently by any homesigner, this does seem to suggest that homesigners are starting to use strategies to try to distinguish agents and patients, even if they are not yet identifying them (e.g., pointing to a location in space and then signing the action, but not explaining which character did the action). This disconnect could be partially a result of difficulties with Theory of Mind (see Gagne & Coppola, 2017) and the task demands of trying to remember too many different characters (12 unique characters in total). Despite this, homesigners are still creating and using many different strategies, some of which are similarly observed in young deaf children acquiring ASL (Hoffmeister, 1986). Therefore, I am hesitant to claim that homesigners do not have any concept of agent and patient because they may indeed

have these concepts but not have the ability to linguistically produce systematic distinctions. However, how homesigners develop these structures is likely different than those with typical language development experiences, which I will address in the next section.

Asymmetries in Pragmatics with Homesigners

The current studies found that homesigners do exhibit pragmatic knowledge, which aligns with previous findings (Safar & de Vos, 2022). However, this raises questions regarding the nature of pragmatic information. What does it mean to have pragmatic knowledge in a situation in which two people not only do not share a common language but also in which one person has essentially created their own language system? Pragmatic usage in a homesigning context is unique because often the communication partner has full access to at least one language (e.g., Spanish or LSN) while the homesigner does not. This creates an asymmetry that does not typically exist otherwise.

So what exactly does it mean to have pragmatic knowledge and use it? In the context of the current studies, there are multiple moving parts involved. Not only must homesigners produce all of the relevant elements and have a way to organize that information for themselves, their communication partners must be able to understand how that information has been organized and what it means. For example, in the context of the Event Pragmatics Task, a homesigner must (1) produce an agent, patient, and action, (2) have a way to distinguish agents and patients, and (3) have a communication partner who understands how this information is packaged. If any one of these three elements are missing, there will likely be a breakdown of communication. Now, of course, part of pragmatic knowledge is realizing when a breakdown in communication has occurred and being able to repair that (see Safar & de Vos, 2022). Communication is a collaborative process and a breakdown in communicative understanding is

not necessarily a failure since it is possible for conversation partners to repair understanding. However, from an efficiency standpoint, being able to effectively communicate meaning on the first try is ideal.

A great deal of research focuses on pragmatics in spoken languages, with relatively little research looking at "cross-signing" situations (i.e., when people communicate without a shared language, using their own sign languages; Bradford et al., 2013). Deaf individuals from different countries are known to be better at communicating with each other than hearing people using different languages (Byun et al., 2018; Zeshan, 2015). This could be partially attributed to previous experiences communicating with others who do not share a language and therefore having gained practice with understanding how to establish common ground and exploit iconic affordances. However, in contrast to signers' experiences, homesigners are attempting to establish communication without having full access to language themselves. Furthermore, they may be communicating with someone who is not sensitive to their linguistic strategies. Hearing mothers of homesigners were significantly worse at comprehending homesign descriptions produced by their deaf adult children than Spanish descriptions from their hearing adult children (Carrigan & Coppola, 2017). In contrast, Deaf native ASL signers, who were unfamiliar with the homesigner or their language system, were significantly better at comprehending homesign descriptions than the homesigner's mothers, even though the mothers have spent decades interacting with their homesigning offspring. Although this study showed mothers video recordings taken about nine years prior (between 2002 and 2004), the current study also demonstrates that even in the moment, communication partners do not always display good comprehension. This suggests that communicative interactions may not be enough to fully internalize the structure of the homesign and to be able to use that knowledge to comprehend

homesign utterances. Experience using a visual-manual language as a primary language and knowing the linguistic conventions used in sign languages, which are also used by homesigners (e.g., using spatial strategies, something that is impossible in spoken languages due to the modality but very common in signed languages), may be necessary.

Homesigners' productions may reflect an interaction between homesigners' lack of access to typical discourse and the incomplete comprehension of their productions by their communication partner. Even in typical situations for children with full access to language and abundant social interaction, pragmatic knowledge takes time to develop, usually well into school-age (e.g., Airenti, 2017; Cekaite, 2013). Homesigners' social network structure means that they rarely observe signed interactions between or among others (Richie et al., 2014). If a person does not have full access to language, and in turn, exposure to models for discourse, how do they develop pragmatic knowledge? Furthermore, what do pragmatic interactions look like when conversation partners do not share a language system or common ground on what typical discourse entails? And how might pragmatic usage shift when communication breakdowns and necessity for repair occurs frequently? Homesigners' pragmatic knowledge and usage may look very different than typical pragmatics, likely because they lack experience with typical discourse (i.e., conversation with two people who share the same language) and often have a lot of experience with communication partners who do not always fully understand them. For example, adult homesigners have been found to produce multiple signs for a single response compared to child and adolescent homesigners who typically produce one sign per response (Quam, Brentari & Coppola, 2022). Goldin-Meadow and colleagues (2015) found that homesigners' handshape forms for nouns became less consistent on subsequent productions when comparing consistency on first productions versus all productions. It is possible that adult homesigners are accustomed

to the experience of needing to repeat themselves in order to repair frequent communication breakdowns with others, particularly since hearing family members are often not great at comprehension of homesign descriptions (Carrigan & Coppola, 2017), so they preemptively repeat signs and utterances in order to give communication partners a better chance at understanding them.

Our work does not claim that an interaction engine does not exist, but rather that the effectiveness of those mechanisms is affected by limited access to language. Humans may indeed have this underlying interactive ability that precedes language (Safar & de Vos, 2022). The fact that homesigners create their own language systems to use with family and friends in the absence of conventional language exposure seems to provide evidence that most humans have a desire to interact with or without typical language access. However, access to language can still impact the nature of these interactions; reduced or minimal language access (and/or language deprivation) likely makes communicative interactions more difficult. Homesigners may need to work harder to make sure they are being understood by others when there is not a shared conventionalized language. This could include using repetition or using multiple strategies (as seen in Goldin-Meadow et al., 2015 and Quam, Brentari & Coppola, 2022). Homesigners' productions and the ways that they use their language system reflect their pragmatic understanding based on their experiences interacting with people who do not always understand them, and are constrained by their limited access to language.

Pragmatic knowledge in a homesigning context is quite different than typical pragmatic usage. Homesigners may be coming from a very different place than their communication partners in terms of discourse experience and linguistic knowledge. It seems that homesigners may develop pragmatic knowledge via communicative interactions and general life experience,

which then helps them to start developing linguistic structures (e.g., spatial strategies, agent/patient distinctions). Communicative engagement might help structure develop, but it does not automatically create structure for homesigners, not without a linguistic community. This is illustrated by the findings from the Event Pragmatics Task in which homesigners often produce all three elements (agent, patient, action) and use a variety of strategies to potentially distinguish agent and patient roles, but none of the strategies are used consistently or systematically and homesigners often distinguish roles without identifying them. There seems to be some kind of interplay between homesigners' communicative experiences (i.e., being the sole primary user of their homesign language system and interacting with people who do not always fully understand them), development of their pragmatic abilities, and the linguistic structures they create in order to try to repair common communication breakdowns.

This type of development is very different from a typical trajectory in which children acquire language first and learn pragmatics much later. However, understanding pragmatic usage in a variety of situations is important. Instead of dwelling on philosophical questions about the nature of pragmatics, I would like to highlight the value in considering the effects of varied language situations, particularly deaf and hard-of-hearing individuals with delayed access to a first language. Most deaf and hard-of-hearing children are born to hearing parents, meaning that most deaf children are not exposed to a sign language starting from birth, delaying or reducing their access to a first language (Mitchell & Karchmer, 2004). Several studies claim that deaf children struggle with pragmatic skills (e.g., Szarkowski, Young, Matthews & Meinzen-Derr, 2020; Goberis et al., 2012; Duncan & O'Neill, 2022), but many of these studies (although not all) do not consider how language deprivation or reduced access to language can impact so many facets of development (Hall, 2017). Deaf children with hearing parents may also have unique

communication experiences, especially if they learn a sign language later on. Investigating different contexts in which pragmatics can be used can help us better understand the nature of pragmatics as well as mental processes that go into conversations, like theory of mind and meta-linguistic knowledge.

Regarding Research with Homesigners

The homesigners in the current study provide us with an opportunity to learn how certain skills and knowledge can develop outside of the influence of typical language experience. However, there are certain things that must be kept in mind when engaging in this research. First, it is important to note that homesigners are not a monolithic group. I use the term homesigner to describe deaf individuals who have limited outside language exposure and innovate their own sign systems to communicate. The homesigners in this study certainly interact with others outside of the home and some have very extensive social networks (see Reed, 2022 for a discussion of "nucleated networks" in Papua New Guinea). The homesigners in the current study come from a variety of backgrounds and situations. Some have very limited social interactions with other hearing people, some communicate a lot with their families, and some do know of other deaf people (LSN signers or other homesigners), even if their interactions with them are infrequent. Our inclusion criteria were that the participant needed to be deaf, communicate using signs, and not have acquired a sign language. We excluded some potential participants during our recruitment phase for not meeting these criteria, such as people who did not use any signs to communicate, already knew LSN, or had another disability that would prevent them from fully participating (e.g., having Usher's Syndrome, a condition in which a person is deaf and subsequently affect by low vision or blindness which would make it difficult for them to see the stimuli). Although some of our participants did have some exposure to LSN (Homesigner 20 has

a deaf younger sister who was late-exposed to LSN, in her late 20s, and Homesigner 22 married a Cohort 1 signer), we ultimately decided to include them after deaf and hearing members of the research team fluent in LSN observed their signing patterns and determined that they were not fully using LSN (e.g., grammar and/or lexicon).

Homesigners 20 and 22 did not demonstrate any major differences in pragmatic usage and event representation from the rest of the participants. In fact, these two homesigners displayed markedly different patterns from each other. In terms of pragmatics, Homesigner 20 did not demonstrate strong production patterns, often producing the necessary information on just over 50% of the trials. In contrast, Homesigner 22 reliably produced the necessary information, especially on the Event Task in which she produced all three elements on every trial. In terms of event representation, Homesigner 20 only used one type of spatial strategy (signer assigns experimenter to patient role), whereas Homesigner 22 used all five spatial strategies at least once and produced paired verb constructions. Additionally, Homesigner 22 was the only participant to use a consistent word order on more than half of the trials (56%).

Because there is such a wide range in homesigners' language experiences, it should not be a surprise that we observed a great deal of variation in their linguistic productions. Therefore, most of the results focused on individual differences in homesigners rather than aggregating all the data and treating homesigners as a homogeneous group. Investigating commonalities among homesigners (e.g., use of space, word order, pragmatic understanding) can offer insight into how language may exert influence in these areas, but we cannot gloss over the intragroup variability. Individual differences are summarized in Table 11.

Table 11. Summary of individual homesigners' patterns. The first two rows note homesigners' pragmatic usage on the Noun-Modifier and the Event Tasks. The next four rows note homesigners' event representation performance and potential strategies for agent/patient distinction. Dashes indicate that the homesigner did not complete the task (i.e., Homesigner 03 did not do the Event Task). The asterisk for Homesigner 19's modifier production indicates that she only produced modifiers on more than 50% of trials on the second run of the task (not the first). Homesigners 02, 03, and 05 are experienced participants. Homesigners 17, 18, 19, 20, 21, and 22 were newly recruited.

	02	03	05	17	18	19	20	21	22
Modifiers produced >50% of trials	✓	✓	✓	✓	✓	✓*	x	x	✓
Agents, patient, actions all produced >50% of trials	✓	–	✓	✓	✓	x	✓	x	✓
Internally consistent word order (>50% of trials)	x	–	x	x	x	x	x	x	✓
Used spatial strategies	✓	–	✓	✓	✓	x	✓	x	✓
Used paired verbs	✓	–	✓	✓	✓	x	x	x	✓
Used patient marker	✓	–	✓	✓	✓	✓	x	x	x

When referring to homesigners in this study, I specified whether they were experienced or new and had a deaf or hearing communication partner. I found that deaf communication partners appeared to have better comprehension than hearing communication partners on the Events Pragmatics task, but how did communication partners' hearing status affect homesigners' productions? New homesigners with deaf communication partners (Homesigners 17, 18, 20, 22) showed patterns similar to experienced homesigners (Homesigners 02, 03, 05; all of whom had hearing communication partners). Specifically on the Event Pragmatics task, all homesigners in both groups produced agents, patients and actions on a majority of trials and used spatial strategies. Most also used a variety of other devices (e.g., paired verbs and patient markers). The participants whose productions did not follow these patterns were new homesigners with hearing

communication partners (Homesigners 19 and 21). This seems to suggest that any experience interacting with other signing people, whether they are regular communication partners (i.e., new homesigners with deaf CPs) or researchers from previous field work trips (i.e., experienced homesigners), might influence homesigners' productions. Future longitudinal work could investigate how homesigners' signing changes the more they interact with other signers.

Many considerations must be made when including homesigners in research. Designing appropriate tasks and stimuli for participants is particularly important for homesigners who do not have full access to language. Instructions and stimuli should be minimally linguistic and designing appropriate procedures and tasks may be difficult but is incredibly necessary. Because of homesigners' unique situations in which accessible language input is minimally available, tests presented to homesigners likely will not be accessible if they include language, so nonverbal tasks must be as nonlinguistic as possible if a homesigner is to engage with them in a meaningful way. Since relying on language is not really an option in this case, tasks that are considered nonverbal may not be useable because they still may involve language in some way. For example, Gagne and Coppola (2017) used an experiential false belief task based on Pyers (2005) with homesigners rather than a traditional narrative version in order to minimize language in the task. In the current studies, this involved using contrastive pictures or videos to elicit utterances and using an eye tracking paradigm that involved anticipatory looking based on simple videos. The pictures and video vignettes may influence some of the linguistic productions. For example, the homesigner might describe exactly what a character is wearing (e.g., long black robes with a collar) instead using a general sign for priest, or replicate the specific action (e.g., tap person's shoulder from behind with right arm outstretched) instead of producing a generic sign for the tapping action. Homesigners may not have lexicalized signs for

many objects and actions; further, it is challenging to ask a homesigner (using language) "what is your sign for X?" Therefore, we must use elicitation materials that (a) are easy to understand and (b) will actually elicit what we are looking for. Additionally, elicitation materials should be culturally relevant and the images and videos should be identifiable and describable by the participants.

Finally, as researchers from the United States, it is important that we engage in this research with respect and care (Singleton, Martin & Morgan, 2015). Since more than half of the participants were newly recruited, it was critical to establish trust and comfortable relationships from the start. For returning participants, we also had to reestablish and maintain those relationships. This can look different for different people, but as a whole, our goal, as researchers going into a community that we are not a part of, is to validate homesigners' experiences and listen to what they have to say.

Limitations and Future Directions

As with every research project, there are going to be tradeoffs for certain issues, and there are several limitations with the current studies. First, which is often an issue with unique populations, is the small sample size. Typically, nine people is not enough participants to have statistical power. Shukla and de Villiers' (2021) eye tracking study had 20 adults in each condition, whereas the current study had 4 homesigners per condition (8 total). Kocab and Snedeker's (in prep) study using the Event Pragmatics Task included 30 Nicaraguan signers, significantly more than the 8 homesigners who participated in the current study. However, studies with homesigners generally have fewer participants because they are a small population and can be difficult to recruit. Indeed, many studies with adult homesigners have very few

participants (Table 12).[4] A dissertation with 9 homesigners is a large number of participants compared to the rest of the literature. Nevertheless, having such a small sample size makes it difficult to have enough power to conduct many statistical analyses and even non-parametric tests for small samples sometimes do not reveal anything. In these cases, qualitative analyses and descriptive statistics can be useful tools to understand individual patterns and trends.

Table 12. List of publications and the number of adult homesigner participants.

Homesigners	Publications	
N=5	Reed, 2022	
N=4	Abner et al., 2019 Coppola & Brentari, 2014 Flaherty, 2014 Gagne & Coppola, 2017	Horton et al., 2015 Richie, et al., 2014 Rissman et al., 2020 Spaepen et al., 2011
N=3	Coppola, 2002 Fusellier-Souza, 2006	Wood, 2013

While the elicitation tasks were successful at encouraging homesigners to produce more information (i.e., modifiers with nouns or two arguments with actions), the tasks were somewhat unnatural, which may have affected the patterns observed. For one, the task prevented a conversational back and forth, directing communication partners to select an answer after the homesigner's first production, even if that utterance was incomplete or unclear. Occasionally, some communication partners did request more information or indicate that they needed more information from the homesigner, but generally they were instructed to make a guess first. This is obviously not regular conversational behavior (though neither are explicit comprehension checks during a conversation), but the goal was to leverage homesigners' pragmatic knowledge

[4] A few publications have reported larger sample sizes of adult homesigners, but they are often taken from previously existing corpora and/or from interconnected networks of homesigners which allow for easier recruitment (e.g., N=14 in Safar & de Vos, 2022).

initially and see if they would produce all of the necessary information from the start of the trial. Regarding word order specifically on the Event Pragmatics Task, it is possible that homesigners' patterns may have been affected by the design of the study. However, subsequent utterances (i.e., homesigners' productions made after input (question or request for more information) from a communication partner) often looked similar to initial utterances, although there were more utterance fragments because the homesigner was often clarifying part of their previous utterance. Both natural conversation and elicitation tasks can provide useful though different information. Although the elicitation tasks were not entirely natural conversation, they allowed us to specifically investigate treatment of agents and patients and production of modifiers, which may have been difficult to elicit via natural conversation alone, especially with the prevalence of argument dropping.

Another minor issue with the elicitation tasks was that a few of the characters and items were unfamiliar to some participants. For example, some homesigners did not distinguish between the American football player and the baseball player, using the same sign for both, which became confusing on the trial that featured both of those characters (i.e., "baseball player kicks football player"). Similarly, some homesigners did not distinguish between a soccer ball and a basketball, either because they were unfamiliar with the sport of basketball and did not understand how to contrast a ball that you kick versus a ball that you dribble/shoot, or because they lacked lexicalized signs for color and could not contrast a black and white ball with an orange ball. These were in only a few trials so this should not have dramatically affected performance. However, in the future, elicitation materials should be piloted and/or reviewed carefully to ensure that they are culturally appropriate.

Nonlinguistic processes can be hard to accurately measure, and this study's eye tracking task runs into a similar problem. After a search of the literature, I decided to use Shukla and de Villiers' (2021) paradigm as it was the only one that satisfied a number of criteria. For one, it did not include any language (several studies were minimally linguistic but still included language in some capacity (e.g., Wilson et al., 2011; Cohn & Paczynski, 2013)). Two, it was appropriate for adults (several infant habituation studies exist (e.g., Woodward, 1998; Golinkoff & Kerr, 1978; Gordon, 2003; Wagner & Lakusta, 2009)). And finally, it was culturally appropriate (tasks that rely heavily on technology (e.g., Hafri, Trueswell & Strickland, 2018) were too unfamiliar for homesigners). To illustrate, we piloted a reaction time computer task based on Hafri, Trueswell and Strickland's (2018) stimuli during our field trip in March 2023. However, homesigners really struggled with the task, with several not fully understanding what they were supposed to do, many getting bored, and almost every participant having issues correctly pressing keys on the laptop as it was an unfamiliar piece of technology for them.

Despite meeting all of the criteria, the task I used still had some issues, the main one being that it is unclear whether we are measuring what we think we are measuring. The eye tracking task used anticipatory looking patterns to assess nonlinguistic concepts of agent and patient. The logic of this paradigm was that if participants were sensitive to the agent/patient contrast, they would learn that the video with the same agent/patient would always turn colorful and play again, and look at the video during the anticipatory period. However, this is based on the assumption that people will look towards the video that they expect to play again, which (a) is not necessarily a given, and (b) may not be directly tied to agent/patient knowledge. The connection between anticipatory gaze direction and agent/patient concepts may not be very salient, therefore, we should use caution when interpreting the findings that (most) homesigners

did not show this anticipatory effect. Gaze patterns may have been influenced by something else, or perhaps the agent/patient contrast in the videos was not obvious enough to warrant attention. Shukla and de Villiers' (2021) found a very small effect size with typical adults, so it is also possible that the sample size (20 versus 8 homesigning participants) had an influence. The authors did find an anticipatory effect for infants and adults doing verbal shadowing on a follow-up study using one-argument intransitive events, so one potential next step could be to run those stimuli with homesigners to see if they also show an anticipatory effect. Alternatively, we might consider trying to design a new paradigm to assess the possibility of nonlinguistic concepts of agent and patient.

Conclusions

This dissertation aimed to investigate broadly how language experience influences the development of thematic roles and pragmatic knowledge, specifically looking at homesigners who have limited to no exposure to spoken or signed language and innovate their own homesign language systems in order to communicate with the people around them. By using novel tasks (i.e., referential communication pragmatics tasks and an eye tracking paradigm) and recruiting a relatively large (for this field of research) number of participants, this dissertation contributes more in-depth knowledge about the role of language in pragmatics and thematic roles in homesign. Specifically, I address both theoretical questions (e.g., Is language required to develop concepts of agents and patients? Can pragmatic knowledge exist without exposure to typical discourse?) and methodological questions. These methodological questions include: will this referential communication task put pragmatic pressure on homesigners and encourage them to produce more information and decrease instances of argument dropping; and will this nonlinguistic eye tracking paradigm work with homesigners?.

I found that homesigners will often use pragmatic knowledge and produce necessary relevant information (e.g., modifiers with nouns or agents and patients with actions). Although homesigners were not always consistent about producing the necessary information, most did so a majority of the time (Studies 1a and 1b). With regard to event representation, as a whole, homesigners did not appear to use systematic conventionalized strategies (e.g., word order, use of space) to distinguish between agents and patients, although I did observe some preliminary strategies (Study 2a). I also did not find evidence that homesigners were using nonlinguistic agent-patient concepts on the eye tracking task (Study 2b). Although these studies suggest that language may be necessary for the development of agent-patient concepts, future research should investigate this further.

Language is deeply intertwined in most of the activities in our daily lives and as a person who has always had immediate access to language, it might be difficult to envision how certain mental processes (linguistic and nonlinguistic) can be drastically affected by the lack of or reduced access to language. Nevertheless, homesigners are able to innovate a great deal on their own, through interactions with engaged communication partners. The findings of this dissertation suggest that basic pragmatic knowledge may not require full access to language, but concepts of agent and patient may require more language to fully develop than previously expected. In the absence of typical language exposure, homesigners' daily communicative interactions and first-hand experiences solving communication breakdowns likely contribute to the development of their pragmatic abilities. In turn, homesigners' pragmatic knowledge may help to start to develop linguistics structures that might, for example, distinguish agents and patients. Communicative interaction does not directly create linguistic structure, but it may play a role in developing that structure via experiences that develop pragmatic skills.

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Appendix A: Noun-Modifier Pragmatics Task Stimuli, Versions 1 and 2

Trial	Target List 1	Distractor List 1	Target List 2	Distractor List 2
1	small bowl	large bowl	brown cow	–
2	large vase	–	cowboy hat	baseball cap
3	small book	–	soccer ball	basketball
4	basketball	soccer ball	large bowl	small bowl
5	large spoon	–	large book	–
6	small dog	large dog	small ball	large ball
7	sunglasses	eyeglasses	eyeglasses	sunglasses
8	black-white cow	–	small spoon	–
9	large bucket	small bucket	high heeled shoe	sneaker
10	rocking chair	–	small vase	–
11	long sleeved shirt	–	short sleeved shirt	–
12	sneaker	high heeled shoe	large dog	small dog
13	semi truck	–	pickup truck	–
14	large ball	small ball	chair	–
15	baseball cap	cowboy hat	small bucket	large bucket
16	small tree	–	large tree	–
17	large bucket	–	small vase	large vase
18	large vase	small vase	large bowl	–
19	basketball	–	chair	rocking chair
20	sunglasses	–	ball	–
21	long sleeved shirt	short sleeved shirt	eyeglasses	–
22	small bowl	–	small spoon	large spoon
23	small tree	large tree	soccer ball	–
24	baseball cap	–	pickup truck	semi truck
25	small book	large book	large dog	–
26	semi truck	pickup truck	short sleeved shirt	long sleeved shirt
27	sneaker	–	brown cow	black-white cow
28	large ball	–	small bucket	–
29	black-white cow	brown cow	cowboy hat	–
30	rocking chair	chair	large book	small book
31	large spoon	small spoon	high heeled shoe	–
32	small dog	–	large tree	small tree

Appendix B: Logistic Mixed Effect Model Results for Both Noun-Modifier Task Runs

First Run (March 2023)

model <-glmer(Modifier_Pres ~ Trial_Type + (1|ID) + (1|Item), family = binomial)

	Includes Modifier (yes) β (SE)
Trial Type (w/ distractor)	**0.693 (0.312)***
Intercept	-0.289 (0.486)
Observations	224
*Note: *p<0.05; **p<0.01; ***p<0.001*	
AIC: 281.4; BIC: 295.1; R^2 = .25	

Random Effects	Variance	SD
Participant ID	1.173	1.083
Items	0.328	0.573
Groups: Items 16; ID 7		

A logistic mixed effects model with trial type (with or without distractor) as a fixed effect and participant ID and stimulus item as random effects found that trial type significantly predicted modifier usage ($t = 2.22$, $p < 0.05$). On trials with a distractor item, homesigners were 1.72 times more likely to produce modifiers on initial utterances.

Second Run (January 2024)

model <-glmer(Modifier_Pres ~ Trial_Type + (1|ID:Item), family = binomial)

	Includes Modifier (yes) β (SE)
Trial Type (w/ distractor)	**1.653 (0.413)*****
Intercept	-0.427 (0.299)
Observations	251
*Note: *p<0.05; **p<0.01; ***p<0.001*	
AIC: 319.85; BIC: 330.42; R^2 = .57	

Random Effects	Variance	SD
ID : Items	3.594	1.896
Observations: 251	*Groups: 128*	

A logistic mixed effects model with trial type (with or without distractor) as a fixed effect and participant ID and stimulus item as random effects found that trial type significantly predicted modifier usage ($t = 3.995$, $p < 0.001$). On trials with a distractor item, homesigners were 2.58 times more likely to produce modifiers on initial utterances.

Appendix C: Descriptions of Event Pragmatics Task Stimuli

Trial	Target List 1	Target List 2
1	clown tickles football player	ballerina tickles chef
2	football player pulls cop	firefighter pulls clown
3	doctor punches clown	soldier chases construction worker
4	baseball player spins doctor	clown pulls firefighter
5	cop tickles baseball player	firefighter punches priest
6	ballerina picks up football player	football player tickles clown
7	chef tickles ballerina	construction worker brushes firefighter
8	chef chases construction worker	doctor punches cop
9	doctor taps soldier	chef kicks soldier
10	priest punches firefighter	doctor brushes bride
11	cop shoves bride	cop pulls football player
12	bride spins ballerina	soldier taps doctor
13	soldier picks up construction worker	priest chases soldier
14	baseball player kicks football player	bride hugs baseball player
15	bride hugs firefighter	priest tickles baseball player
16	construction worker spins priest	firefighter hugs clown
17	clown hugs firefighter	football player kicks baseball player
18	soldier kicks chef	football player picks up ballerina

Appendix D: Additional Figures from Nonlinguistic Eye Tracking Study

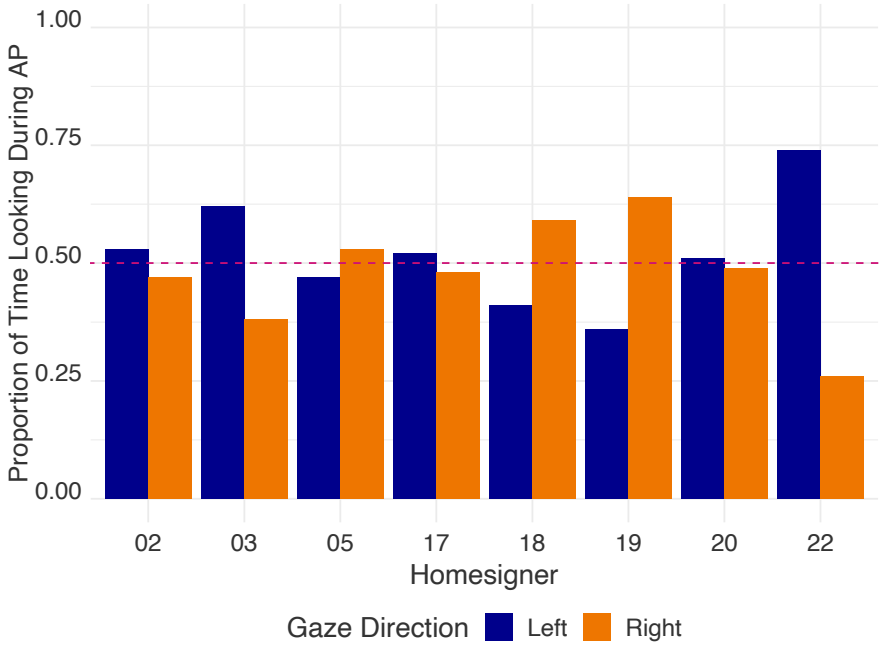

Figure 18. Proportion of overall time looking to the left and right during the AP. The dotted red line represents looking randomly (at chance, 50%).

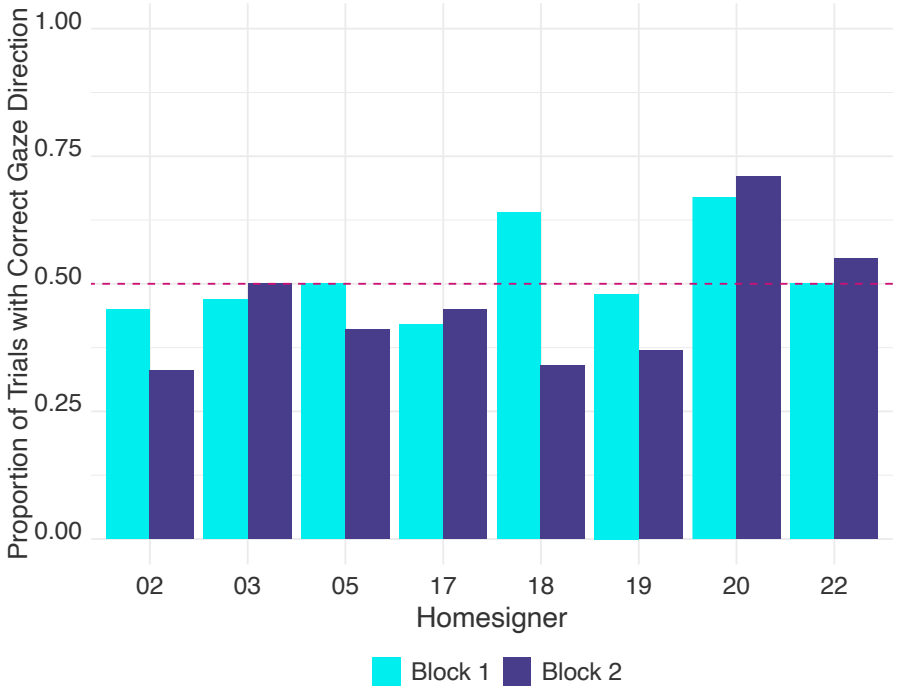

Figure 19. Proportion of trials with correct gaze direction split up by block. Three homesigners (18, 20, 22) performed above chance (red dotted line, 50%) on at least one block.

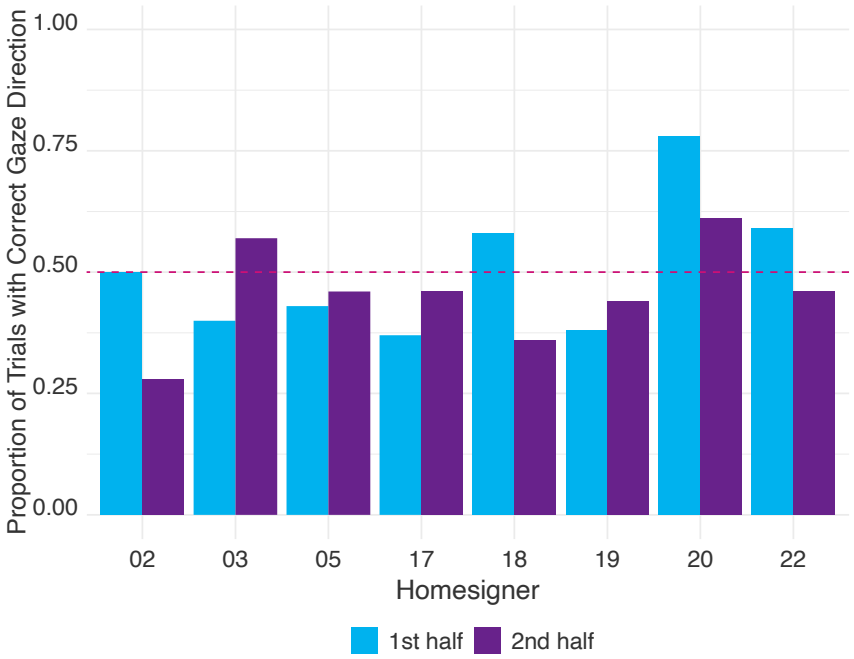

Figure 20. Proportion of trials with correct gaze direction split up by block halves (first halves of blocks 1 and 2 versus second halves of blocks 1 and 2). Four homesigners (03, 18, 20, 22) performed above chance (red dotted line, 50%) on at least one of the halves.

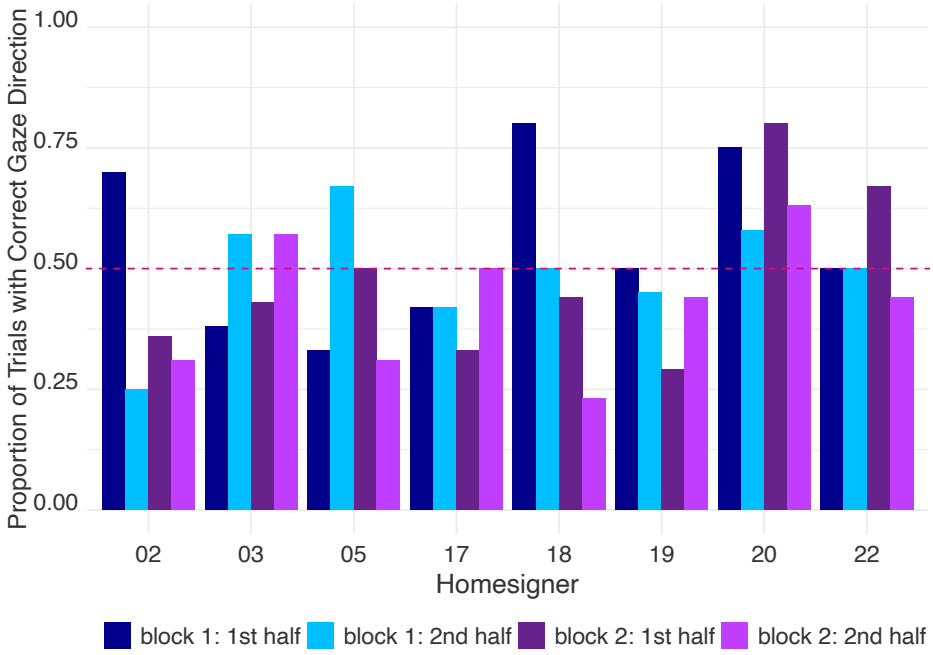

Figure 21. Proportion of trials with correct gaze to target side split up by block and by half. Blue colored bars represent block 1, purple colored bars represent block 2. Darker colored bars represent the first half of the blocks, lighter colored bars represent the second half of the blocks. Six homesigners (02, 03, 05, 18, 20, 22) performed above chance (red dotted line, 50%) on at least one of the sections.