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Reference tracking strategies of deaf adult signers in Turkish Sign Language

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ABSTRACT

We investigated the reference tracking strategies among deaf adults with signing deaf parents (DoD) and adult deaf signers with non-signing hearing parents or caregivers (DoH) who had late exposure to Turkish Sign Language (TİD). Consistent with the theories of saliency and referential accessibility, regardless of their acquisition groups or parental hearing status, signers mainly used nominals and extension classifiers for introducing referents. To maintain a referent from the previous clause, the signers used zero anaphora (e.g., constructed action, agreement and plain verbs). For topic shifts or re-introduced contexts, nominals and pronouns were chiefly favored although we observed very little pronominal use. As for the effect of native acquisition from deaf caregivers, we only report limited over-redundancy for DoH signers who used zero anaphora less compared to DoD especially for introduced and maintained contexts. We conclude that DoH signers are still able to achieve native-like competency in terms of reference tracking in simple narratives but DoD signers utilize the spatial affordances of the visual-spatial modality better than DoH signers only to a certain extent.

1. Introduction

Narratives are extensive discourses that form an important part of human communication. In order to create a systematic and coherent organization of experiences, narrators must choose appropriate linguistic forms to refer to entities (Ariel, 1990; Givon, 1983; Gundel et al., 1993). Certain forms such as nominal expressions are commonly used for the first mention of a referent in a discourse, and other forms such as pronouns and zero anaphora may track previously mentioned entities which could either be maintained across multiple clauses or re-introduced back into the discourse. The selection of these referring expressions (henceforth REs) is contingent on cognitive abilities, such that individuals must rely on the activation of the working memory to keep in mind previously referred expressions and long strings of information (Bamberg, 1997; Morgan, 2005). Pragmatic abilities too play a pivotal role in the tracking of referents. The form with the least amount of redundant information must be selected based on the accessibility levels of the referent (i.e., how active a referent is in the addressee's mind given a point in discourse) (Ahn, 2019; Ariel, 1990). Because of these cognitive and pragmatic necessities, it is not surprising to observe that producing a coherent narrative is one of the latest milestones in language acquisition among children (Hickmann et al., 1996). As can be expected, there is a plethora of research examining how narrative competence is achieved in both monolingual and bilingual acquisition contexts among children and adults. Although narrative competence and referent

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selection have been studied extensively for typically developing speakers (Aksu-Koç and Nicolopoulou, 2015; Hickmann et al., 1996; Williams, 1988), deaf individuals who acquired a sign language in atypical learning contexts (i.e., deaf signers with delayed exposure to a sign language) have remained mostly understudied with an exception of a handful of studies (Becker, 2009; Cormier et al., 2013; Gür, 2018). Nevertheless, it is paramount that we investigate and describe the effects of late exposure to a sign language among deaf adults growing up in a signing vs. non-signing environment on narrative competence more in depth. This will help us understand whether the lack of systematic and frequent language exposure in the early years of life affect how deaf signers produce a narrative in their adulthood. Given this, the present study will focus on two groups of signers and examine their reference tracking strategies in signed narratives: (i) deaf of deaf (DoD) adult signers (i.e., signers who have deaf caregivers and natively acquired a sign language from birth) and (ii) deaf of hearing (DoH) adult signers (i.e., signers who have hearing non-signing caregivers and state to have started acquiring a sign language later in life).

Sign languages are the natural languages of the Deaf communities all around the world. They are independent languages, which do not derive from majority spoken language(s) but emerge naturally when deaf people form a community. Turkish Sign Language (Türk İşaret Dili – TİD) is and has been the officially recognized language of the Deaf community in Turkey since 2005 (see Nuhbalaoglu, 2018 for a brief review of the historical development of the language). Deaf or hearing children acquiring a SL within a family where there is one or more deaf caregivers display the same developmental milestones as hearing children acquiring a spoken language in a hearing family (Chamberlain et al., 1999; Meier and Newport, 1990). However, reports indicate that over 90% of all deaf individuals are born into hearing families (DoH) who do not know how to sign (Woll, 2013). This means that the auditory modality used in the household is not accessible to many deaf children. That is why the age of acquisition of a first functional language varies greatly among deaf children, with many of whom being deprived of their first languages typically until after age 7 when they start formal education in a deaf school, especially in the context of Turkey (Sari, 2005). Despite this, many of the early intervention programs for late signing children prioritize spoken language development and discourage the use of a sign language (Kemaloğlu and Kemaloğlu, 2012). The Ministry of National Education (2020) identifies 72 deaf schools in Turkey for the K-12 level. Even when deaf children with hearing parents start their formal education in one of these schools, they do not receive proper instruction in TİD since the teachers themselves are mainly hearing and only have a very rudimentary knowledge of a sign language (Ilkbasaran, 2015; Sari, 2005). In some cases, it has been argued that late exposure to a sign language among certain DoH signers has negative effects on some cognitive and linguistic measures. To name a few, delayed exposure to a first functional language is reported to negatively affect deaf children and adults' morphosyntactic production and processing (Boudreault and Mayberry, 2006; Cheng and Mayberry, 2021; Cormier et al., 2012; Karadöller et al., 2017; Kayabaşı and Gökgöz, 2022; Newport, 1990) and narrative abilities (e.g., Becker, 2009). In our overall research, we are concerned with the effects of this late exposure in the ultimate adult forms of TİD users.

1.1. Referring expression (RE) selection

Natural languages can be systematically used to keep track of previous referents in the discourse and mark the changing cognitive statuses of the REs (i.e., from being active to less active in the addressee's mind) to create a more coherent narrative. Among the theoretical frameworks that aim to explain that different linguistic forms are selected in accordance with the addressee's mental representations of the referents in the discourse is the Givenness Hierarchy (Gundel et al., 1993). According to this model, given or familiar information is expressed in more attenuated forms such as pronouns and zero anaphora (i.e., there is no explicit mention of the referent) since the mental status of the expressed referent is already at the center of attention, as indicated by the present contextual information (Chafe, 1976). The Givenness Hierarchy is akin to other previously proposed models of reference control within the topicality and saliency paradigm such as the Accessibility Hierarchy (Ariel, 1990), Topic Continuity (Givon, 1983), and Familiarity Scale (Prince, 1981). Gundel et al. (1993) argued that the distribution of forms is not random but abides by the Gricean Maxim of Quantity (Grice, 1975). That is to say, individuals must make the most informative and succinct choice possible to retain economy of form. When multiple expressions are available for the same referent as in an utterance like (1), phonetically simplest form is selected with the least redundant information based on an economy principle. In the utterance, REs for "Eddie" are given in bold. All three REs (nominal, pronominal, and zero anaphora) refer to the same entity; however, the quantity of marking decreases as the referent's accessibility increases. On this ground, for highly accessible referents (i.e., those that are highly active in the mind), linguistic forms with the least phonetic content are selected for the least amount of processing effort.

(1) So **Eddie** turned around. Williams (1988; p. 343, ex. 7)
He said, "youse got a problem?"
"Yeah, we want you," they say. So-∅ walked right up to them

It is also possible to categorize REs into three according to their discourse status (Gullberg, 2006). A referent can be introduced or mentioned for the first time, maintained, that is, continued across two or more clauses, or re-introduced into the discourse following a topic shift. As a result, interlocutors mark some REs differently than others based on the principles of reference accessibility. For spoken languages, this observation is well established (Ahrenholz, 2005; Ariel, 1990; Azar and Özyürek, 2015; Chafe, 1976; Debreslioska et al., 2013; Givon, 1983; Gundel et al., 1993; Hickmann et al., 1996). These

research indicate that the introduction and re-introduction of a referent are often accomplished by full noun phrases which can be commonly modified by an adjective or demonstrative. Maintenance, on the other hand, is typically marked with pronominals and zero anaphora since the continued referent is still highly accessible to the addressee.

However, this particular observation is not peculiar to spoken languages. There is an emerging body of literature that reports the distribution of REs in signed narratives (Ahlgren and Bergman, 1994; Czubek, 2017; Ferrara et al., 2022; Frederiksen and Mayberry, 2016; Garcia et al., 2018; Garcia and Sallandre, 2014; Hodge et al., 2019; Morgan, 2005; Perniss and Özyürek, 2015; Swabey, 2002). Building on the work by Gundel et al. (1993), Swabey (2002) demonstrated that, like other languages such as Russian, Chinese, and Japanese, American Sign Language (ASL) signers use bare nouns for introduced and re-introduced discourse contexts whereas zero anaphora is used for referents which are "in-focus" or very accessible to the addressee. Overt REs like pronouns or nouns are disprefered for such referents. Swabey (2002) concluded that "native" signers in her study abided by the Gricean maxim of quantity and thus used more economic forms of reference tracking. Similar findings have been reported for German Sign Language (Deutsche Gebärdensprache - DGS) (Perniss and Özyürek, 2015) and British Sign Language (BSL) (Morgan, 2005). It is important to note, however, that this research either collapsed DoD and DoH signers into a single group and labeled them as "native-like" or explicitly compared native deaf signers with late deaf signers (with delayed exposure to a sign language) in terms of narrative competence. Most recently, Ferrara et al. (2022) examined corpora including video-recorded narratives from five different sign languages including Irish Sign Language, Finnish Sign Language, Norwegian Sign Language and Swedish Sign Language and investigated how these languages established and maintained referents. Like other observations, this research showed that, across each of these languages, bare nouns were used to introduce new referents and zero anaphora or more reduced forms were preferred for referent maintenance.

1.2. Linguistic tools for tracking referents in signed narratives

The linguistic inventory for discourse referents can include nominal constructions (bare nouns, fingerspelled nouns, and modified nouns), null or zero anaphors[1] (predicated by a plain verb, an agreement verb, or constructed action), classifier predicates (whole entity classifiers, body part classifiers, handling classifiers, and extension classifiers), and overt pronouns (pronominal index or IX) (Frederiksen and Mayberry, 2016). This interim section describes such forms attested for sign languages under four main headings (nominals, pronouns, classifiers, and zero anaphora).

1.2.1. Nominals

In TİD and many other sign languages, it is possible to use bare nouns as in 2a as well as fingerspelled nouns as in 2b. Fingerspelling refers to the use of the manual alphabet to spell all or part of the letters of a word borrowed from a surrounding written language (Kubuş, 2008). Nouns can also be modified by a prenominal or postnominal extended index finger pointing sign, glossed as IX, functioning as a determiner or a demonstrative as in 2c (Maclaughlin, 1997) or by a modifying classifier within the same NP as in 2d (Frederiksen and Mayberry, 2016).[2]

(2) a. Full noun

Gloss: MOUSE[3] SICK
Status: Intro.
Context: Narration 6, Event 1. Here, the signer introduces the mouse, Jerry, at the beginning of the narration with a bare noun.
Translation: There is a sick mouse.

[1] Zero anaphora does not refer to the lack of a referent. It only alludes to the non-presence of a more explicit anaphoric form for the referent such as a nominal, pronominal, or classifiers.

[2] Spoken languages use pronouns, determines and demonstratives where sign languages use a pointing sign, usually glossed as IX, which assumes similar functions (Lillo-Martin and Klima, 1990). In addition, the pointing sign is used to referentially anchor a referent to a location in signing space.

b. Fingerspelled noun

Gloss: T- -O- -M COME.BACK
Status: Re-intro.
Context: Narration 7, Event 2. The signer introduces Tom two sentences before. She introduces the black cat in the preceding clause and then here re-introduces Tom by using fingerspelling.
Translation: Tom comes back.

c. Noun modified by index (IX)

Gloss: IX CAT PIPE.EXTEND GO.THROUGH EXIT
Status: Re-intro.
Context: Narration 1, Event 6. The signer introduces the cat in the first clause of the first event and re-introduces it several times including this last event of the narrative.
Translation: The cat goes through and exits the thin pipe.

d. Noun modified by classifier (CL)

Gloss: SOAP SOAP.CL
Status: Intro.
Context: Narration 5, Event 3. Here the signer introduces the soap to the discourse. The signer produces the lexical sign, SOAP, plus a classifier, SOAP.CL.
Translation: The soap, which is like this.

1.2.2. Referential use of space and pronouns

In addition to being a modifier of a noun, the IX sign can also be pronominal by referring to established nominals through pointing to a previously assigned abstract or physical locus in the signing space when re-introducing a topic in discourse (Emmorey, 1996). This function has also been identified for TİD (Sevinç, 2006). The example in 3a illustrates this spatially-anchored pronominal use.[3]

[3] We use small capitals to indicate sign glosses.

(3) a. Pronominal

Gloss: IX LOOK CAT.SAD(CONSTRUCTED ACTION) SAD SICK
Status: Re-intro.
Context: Narration 9, Event 1: The signer introduces the mouse then signs an action of the cat. Here, he re-introduces the mouse with a pointing sign that functions as a pronoun.
Translation: It (the mouse) looks sad and sick.

These pronominal signs are rarely used for the first mention of an entity (Perniss and Özyürek, 2015). Other researchers consider pointing signs without noun phrases as examples of demonstratives and not personal pronouns (Koulidobrova and Lillo-Martin, 2016). It is also important to mention here that in some spoken languages (e.g., German and Dutch), demonstratives can also refer to persons (Bosch and Umbach, 2007) and behave similarly to personal pronouns. However, for the purposes of the present study, we will refer to IX signs as pronominal IX and particularly examine their non-deictic or personal pronoun realizations as a possible discourse strategy to mainly mark topic shift (re-introduction) among DoD and DoH signers of TİD.

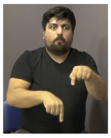
1.2.3. Classifiers

In sign languages, a verbal classifier morpheme is morpho-phonologically encoded by a handshape. This handshape is articulated co-temporally with a movement that encodes the verbal meaning (Benedicto and Brentari, 2004; Supalla, 1990). Semantically, the classifiers denote sets of objects based on criteria such as animacy, size, shape, body-part, texture and sometimes function (Talmy, 2003). The classifier articulated simultaneously with a movement is called a classifier predicate and the sentence in which such a predicate is used is usually called a classifier construction in sign language research. As in most sign languages hitherto studied, classifier constructions are also commonly found in TİD (see Dikyuva et al., 2015 for a review). Following the classification of (Engberg-Pedersen, 1993), in TİD, we distinguish between four types of classifier handshapes. Whole entity classifiers (WECL) represent the entirety of a referent (e.g. an entire flat horizontal entity, or an upright entity) (e.g., 4a) whereas body part classifiers (BPCL) represent a specific part of an animate entity (e.g., limbs, head, mouth, tongue, or teeth, etc.) (e.g.,4b). Handling classifiers (HCL) occur with transitive verbal roots and represent both the size, shape and surface of an object and how that object is handled or manipulated by an agent (e.g., 4c). Extension classifiers (ExtCL), on the other hand, represent the size and shape of an entity by following a trajectory to trace its shape (e.g., 4d). We exemplify these handshapes with the discourse status of the referent they track and a description of the previous discourse when available.

(4) a. Whole entity classifier (WECL)

Gloss: TWO.MICE.GO.TOGETHER
Status: Maintain.
Context: Narration 4, Event 2: The signer introduces Jerry and the robot mouse in the preceding clause. She maintains reference to them by using a whole entity classifier on each hand.
Translation: (Jerry and the robot mouse from the previous context) go together.

b. Body part classifier (BPCL)

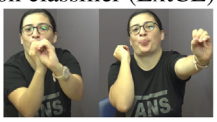


Gloss: CAT.MOVE.THIN.LEGS
Status: Maintain.
Context: Narration 1, Event 6: The signer re-introduces the cat three clauses before and maintains reference to him in the two clauses before and here with a body part classifier that refers to the legs of the cat.
Translation: (The cat) walks (i.e. moving his thin legs forward).

c. Handling classifier (HCL)

Gloss: ROPE SEE-3A SOON GO CAT.PULL.ROPE
Status: Maintain.
Context: Narration 5, Event 2: The signer introduces Tom three clauses before. She maintains reference to him in the preceding two clauses and here she still maintains reference to him by using a handling classifier on both hands.
Translation: When (he/Tom) sees the rope, (he) soon goes to pull it.

d. Extension classifier (ExtCL)



Gloss: CAT.EXTEND
Status: Maintain.
Context: Narration 1, Event 6: The signer re-introduces Tom two clauses before and she maintains reference to him with constructed action in the previous clause and here with an extension classifier.
Translation: (The cat) extends thin.

1.2.4. Zero anaphora

Parallel to spoken languages, many sign languages have been reported to allow null subjects and/or objects and make use of null arguments when referring to highly accessible referents that are still active in the mental representation of the addressee. In signed discourse, this can be achieved by employing certain verbal constructions or constructed action (CA). The latter construction exemplified in 5a refers to cases in which the signers engage with the space in front of themselves as if they are characters in the story interacting with objects and other characters. This is often achieved with the signer taking on the role of a referent in the narrative and performing the actions (Metzger, 1995). CA is often marked by certain non-manual cues such as the facial expression and the breaking of the eye contact. This is to say, the narrator's head, face, torso, arms, and as an optional marker, hands represent those of the associated referent(s) (Smith and Cormier, 2014). As for the verbal constructions, to identify the predicate types in ASL, Padden (1986) suggested a triadic categorization of verbs in sign languages: plain verbs, agreement verbs, and spatial verbs. According to this classification, plain verbs (as in 5b) do not agree with the subject or the object. This means that they are not inflected for number or person. This contrasts with agreeing verbs (as in 5c) the starting or the ending point of which can be modified to specific loci for person and number agreement while spatial verbs (as in IX BOOK PUT 'I placed the book there') agree with locative arguments but like plain verbs, they are not inflected for number or person. TİD too licenses null arguments. Following this classification, Sevinç (2006) argued that

although it is common in TİD to drop arguments, there were certain limitations on the null marking of the arguments for agreement and plain verbs.

In terms of referential accessibility, zero anaphors predicated by such constructions in narratives are assumed to rank last in the hierarchy, preceded by nominal classifiers and then pronouns and other nominal forms. The reason that we distinguish zero anaphora from classifier handshapes or predicates (which can also be considered implicit markers of reference) is because classifiers typically denote certain topographic or semantic properties (e.g., size and shape) of the referent noun due to their iconic nature. They are not as explicit as pronouns or nouns since they do not target a specific individual (e.g., EDDIE) in a set but rather they refer to a set of individuals that are semantically similar to each other (Morgan, 2005). For example, the extended index finger can be used to refer to a human entity. Finally, zero anaphors predicated by constructed action, agreement and plain verbs are least explicit forms of referent tracking since the implicit nature of such constructions do not easily restrict the referent set based on cues such as size, shape or semantic category. In other words, zero anaphora requires preceding context or information the most compared to other forms.

(5) a. Constructed action

Gloss: MOUSE.STAY.LIKE.THIS
Status: Maintain.
Context: Narration 6, Event 9: The signer re-introduces Jerry in the previous clause and maintains reference to him by using this constructed action.
Translation: (The mouse) stays like this.

b. Plain verb

Gloss: RUN.AWAY
Status: Re-introduce.
Context: Narration 5, Event 4: In this sentence, the signer re-introduces Jerry with the plain verb RUN.AWAY.
Translation: (Jerry) runs away.

c. Agreement verb

Gloss: 3A(MOUSE)-HIT-3B(CAT)
Status: Maintain.
Context: Narration 8, Event 2: The signer introduces Jerry in the preceding clause and maintains reference to him by using the agreement verb HIT.
Translation: (Jerry) hits (Tom).

1.3. Learning how to track referents in sign languages

In both communication modalities (visual and auditory), children start to produce more complex and coherent stories with appropriate and informative linguistic forms to indicate anaphoric or cataphoric references after age 10 (Hickmann et al., 1996; Rathmann et al., 2007). Prior to this age, both signing and speaking children fail to refer to entities consistently since their pragmatic abilities are yet to develop. The manipulation of linguistic forms for discourse functions to signal topic continuance or shift is difficult to master until the beginning of formal education. These findings are also comparable across different sign languages including BSL (Morgan, 2005), ASL (Loew, 1984), and DGS (Becker, 2009), pointing out to the fact that

the mastery of reference tracking in narratives is one of the most protracted achievements in the acquisition of signed discourse.

Like in first language development, narrative skills have been extensively studied among second language learners (see Bel et al., 2015; Frederiksen and Mayberry, 2019). Comparing 11 deaf adult signers and 13 hearing advanced learners of Catalan Sign Language (Llengua de Signes Catalana - LSC), Bel et al. (2015) found that hearing signers resort to more overt forms (nominals and pronouns) than native deaf signers to avoid potential ambiguities among referents. Nevertheless, their results did not reach statistical significance for the interaction of discourse status and acquisition group. However, the control group here consisted of both deaf signers who had one or more deaf parents and also deaf signers who had hearing parents and their age of acquisition varied. Out of 11 deaf L1 signers in Bel et al.'s (2015) control sample, 5 had deaf parents and acquired LSC from birth, and the other 6 had hearing parents but their exposure to LSC started before age 5. A similar line of research came from Frederiksen and Mayberry (2019) who found a statistically significant difference between both groups, that is DoD signers and hearing L2 learners of ASL, only for classifier use especially in re-introduced contexts. L2 learners in the study used more nominals and fewer instances of zero anaphora in number, indicative of a limited effect of overexplicitness among second language learners. Although Frederiksen and Mayberry's control group included some signers with hearing parents, they had all learned to sign from birth since they received sign language input from older deaf siblings.

Still, only very few researchers explicitly compared DoD (i.e., deaf signers with native exposure to a sign language) and DoH (i.e., deaf signers with delayed exposure to a sign language) also display redundancy in their reference tracking. Becker (2009) examined 6 DGS signing deaf children's (3 native and 3 late) narrative abilities. She reported that late signing children generated more explicit forms such as nominals when referring to the characters in the story compared to native learners, concluding that first language deprivation results in an inadequate representation of the addressee and less efficient use of morphosyntax. Comparably, Cormier et al. (2013) investigated the use of CA in BSL among 15 deaf native, early, and late adult signers (5 participants in each group) and found that DoH signers were redundant in topic continuity. In other words, the DoH signers produced more explicit forms like nominals, and fewer instances of zero anaphora when maintaining previous referents. Most relevantly to the present study, Gür (2018) studied the development of narrative skills among 10 native and 10 late deaf children and deaf adult signers of TİD. She found that native-signing children and adults had more instances of explicit referent introduction, set the scene more frequently, and employed CA in an appropriate manner more than corresponding late-signing children and adults. Although this study presented preliminary findings on age of acquisition effects on narrative competence, it does not investigate how DoD and DoH signers employ different linguistic tools based on the accessibility of the referent. Therefore, to our knowledge, there is a lack of research directly examining the effects of first language delay especially among deaf adult signers with non-signing hearing parents on the selection of REs in signed narratives.

Considering this, it is also not very clear whether the age of acquisition effects on narrative abilities, observed among late signing deaf children, hold when they become adults. Understanding the impact of delayed first language learning on narrative competence is crucial for three reasons. First, studying signers from this population will shed light on the possible effect of lack of early language experience on future cognitive and pragmatic abilities since the narrative competence is dependent on such faculties. Second, examining reference tracking strategies in particular will also inform about the linguistic inventory that DoD and DoH signers use to refer to entities. Finally, any possible difference between the two acquisition groups in terms of narrative competence will have further practical implications for the importance of early access to a first functional sign language to retain future linguistic and cognitive abilities.

1.4. Present study

In an attempt at addressing this gap in the literature, the present study aims to investigate the reference tracking strategies of DoD and DoH adult signers in TİD narratives with a story-telling paradigm. We explore the forms available for referent tracking in TİD and examine the nature of RE selection as an indicator of possible pragmatic differences between the acquisition groups.

Overall, considering what has been suggested for the distribution of REs in signed narratives, we expect more explicit forms like nominals for referent introduction and less explicit forms such as zero anaphora, pronominal and/or classifier use for referent maintenance. For the re-introduction contexts, where referents which are discontinued across one or more clauses are brought back into the discourse, we expect a less clear picture. Some re-introduced referents will have higher accessibility and will thus be tracked with more implicit REs, while others that have lower accessibility will be tracked with more explicit REs. Also, based on previous research, we hypothesize that DoH signers will be more over-redundant in their reference tracking compared to DoD signers. This would translate to a preference by DoH signers for nominals over zero anaphora especially in maintenance and re-introduction contexts. In contrast, we would expect that DoD signers use more zero anaphora to track referents.

2. Method

2.1. Participants

We tested 29 deaf adult signers, 15 DoD signers with exposure to TİD from birth from deaf caregivers (e.g., parents or siblings), 14 DoH signers who had hearing caregivers and were exposed to TİD between ages 3 and 17 ($M_{\text{Age of acquisition}} = 7.7$

years, $SD = 3.3$ years). As a result, the criterion to be classified as a DoH signer was to have hearing and non-signing caregivers. All the signers satisfying this criterion were regarded as such.[4] Detailed information about the linguistic and educational background of the participants can be found in Appendix A.

All participants indicated that their preferred language of communication was TİD which they used for most contexts. 1 DoD signer was excluded from the data analysis because they self-reported to have signing deaf parents but also only used home sign (a more crude form of communication) at home. As a result, we present data from only 14 DoD signers.

All participating DoD signers (7 males, 7 females) were born into deaf signing families and started acquiring TİD from at least one of their caregivers after birth. The parents of 14 participating DoD signers were deaf. One native signer had a deaf father and a hearing mother. In addition to TİD, the home language for some DoD signers (n = 4) in early childhood included the use of home sign.[5] The age of the native participants ranged between 18 and 35 ($M = 26.4$ years, $SD = 5.0$ years) This also corresponded to the total average years of TİD use for DoD signers. All DoD signers were pre-lingually deaf, that is they were either born deaf or they had become deaf before the age of 3, with the exception of one signer who became deaf between the ages of 4 and 7. DoD signers reported to complete at least high school education and their level of education (LOE) was between 12 and 16 years ($M = 12.7$ years, $SD = 1.5$ years). In addition, all native participants attended at least two deaf schools, one being primary and the other middle school. 10 native participants also attended a deaf school for their high school education. Based on a self-reported 5-point scale of proficiency (1: poor, 5: proficient), native participants declared that they have high receptive and productive skills in TİD ($M = 5$ points, $SD = 0$ points). As for their proficiency in (spoken) Turkish, their self-reported rankings were on average 3.7 ($SD = 0.7$), 3.7 ($SD = 0.7$), and 2.6 ($SD = 1.2$) for reading, writing, and speaking abilities, respectively.

Comparably, DoH signers (8 males, 6 females) were all born into hearing non-signing families and started learning TİD later in life after age 3, usually with the start of formal education. The age of sign language acquisition for DoH signers ranged between years 3–17 ($M = 8.7$ years, $SD = 3.5$ years). The caregivers of all participating DoH signers were hearing, and the reported home languages used in childhood mainly consisted of Turkish and home sign. The average age of DoH signers was 34.6 years ($SD = 8$ years) and ranged between 24 and 50. The derived mean number of years for TİD use following its acquisition was comparable to DoD signers with 25.9 years ($SD = 7.9$ years). Except for two signers who became deaf between the ages of 4 and 7, all the other DoH signers were pre-lingually deaf. All DoH signers completed at least middle school education and the year of schooling ranged between 8 and 16 years, and the average was 12.3 years ($SD = 2.8$ years). All of the DoH group attended at least one deaf school. While 8 participants attended two deaf schools (either primary and middle school, or middle and high school), 3 participants reported to attend three deaf schools. Using the same scale, the signers self-rated their abilities in TİD and Turkish. Both of their receptive and productive TİD abilities rated on average 4.9 points ($SD = 0.3$ points). DoH signers' mean rating for their reading abilities in Turkish was 3.5 points ($SD = 0.7$ points) while their writing and speaking abilities rated on average 3.4 ($SD = 0.5$ points) and 3.1 points ($SD = 0.7$ points), respectively.

Both groups' sex, average years of schooling, TİD use following its acquisition, and their self-reported receptive and productive TİD ratings, and their reading, writing, and speaking ratings for Turkish did not statistically differ; Bayesian p's > 0.1. However, participants' ages statistically differed between the two acquisition groups; $t(27) = 3.4$, Bayesian $p < 0.01$. Overall, the DoD group consisted of younger participants. This was to ensure that the average years of TİD use among DoD signers approximated those of DoH signers.

2.2. Stimuli

We used a story-telling paradigm to examine how DoD and DoH signers of TİD track reference in signed discourse. Participants were presented with 10 short video clips extracted from the cartoon *Tom and Jerry* and asked to retell them. Each clip had six to ten episodes ($M = 8$ episodes). The duration of the clips ranged from 17 s to 28 s ($M = 22.7$ s). The narratives included on average 2 recurring animate characters for which the present context required the introduction, maintenance, and re-introduction of referents. In addition, in each narrative, there were on average 2 inanimate objects with which the animate referents interacted. The detailed description of the episodes in each narrative can be found in Appendix B.

2.3. Task procedure

Participants sat in front of a laptop computer which had the stimulus stories. The instructions were all given by a deaf research assistant who was present in all sessions and ensured that the task requirements were clear. The informed consent form was translated into TİD and explained to the participants by the same assistant before data recording. Participants filled in the consent form and a background questionnaire form before the onset of the trials. Following this step, signers were seated across a hearing researcher who is an advanced late learner of TİD. We instructed the participants to narrate as they

[4] Although we did not set a cut-off point for nativeness, all the deaf of hearing participants indicated that they learned TİD after age 3. In order to capture in-group variation among DoH signers, we run an additional supplementary analysis in which we observed very wide credible intervals due to the small group size, rendering the results uninformative. For the analysis, see Appendix E.

[5] Home signs are gesture-based communication systems that emerge between the deaf children and their primary caregivers. Although home sign communication may have internal consistency, they are not fully-flegged linguistic systems like natural languages.

would to a deaf friend. We gave this instruction to make sure that signers naturally sign, and simply do not try to simplify or adjust their language to the level of the addressee. All trials were recorded by a digital camera placed in front of the signers. The participants were instructed to watch the narrative clip as many times as they needed, and narrate the content of each clip either to the experimenter or the recording digital camera.[6]

Table 1
Annotation Tiers with their Tags and Descriptions.

Tier	Tag	Description
Clause Boundary		The boundary between clauses indicated by the presence of predicates and/or certain prosodic cues (e.g., head nod)
Discourse Status	Introduced	A first mention of an entity in a given discourse regardless of any syntactic role
	Maintained	A subject referent continued across two or more immediate clauses
	Reintroduced	A subject referent discontinued across at least one clause
RE Type	NOM: Bare Noun	A non-modified noun phrase (e.g., CAT, MOUSE)
	NOM: Modified Noun	A noun phrase modified by an index sign, classifier etc.
	NOM: Fingerspelled Noun	Borrowed nouns from Turkish spelled by the manual alphabet (e.g., K-E-D-İ 'cat')
	PRO: Pronominal IX	An index sign used in isolation to refer to an entity in discourse
	CL: Whole Entity Classifier	A handshape that refers to the entirety of an entity
	CL: Body Part Classifier	A handshape that refers to a part of an entity
	CL: Handling Classifier	A handshape that refers to the handling of an item
	CL: Extension Classifier	A handshape that denotes the size and shape of an entity
	ZERO: Constructed Action	A multifunctional construction where the signers take on the role of a referent and perform their actions
	ZERO: Plain Verb	A non-agreeing predicate (e.g., LOVE)
	ZERO: Agreement Verb	A predicate the beginning and ending of which agree with the person and number

Note: NOM = nominal, PRO = pronominal, CL = classifier, ZERO = zero anaphora.

2.4. Data annotation

We coded the discourse status (Introduction, Maintenance, Re-introduction) and RE type (Nominal, Pronominal, Classifier, Zero Anaphora). We used ELAN Linguistic Annotation Software (Crasborn and Sloetjes, 2008) for data annotation. First Author who is a hearing signer of TİD annotated all the data and translated the narratives into Turkish together with a native deaf signer of TİD.

Following Berman and Slobin (2013), we first identified the clause boundaries in each sentence indicated by the presence of predicates and informative non-manual markers (e.g., head nod). On the second tier, we coded the discourse status for each referent. Having adapted the classification of Gullberg (2006), we considered all referents mentioned for the first time as introduced regardless of their syntactic function in the sentence. Only subjects were coded for maintenance and re-introduction. We coded subject referents as maintained only if they had been referred to in the previous clause. To this end, the referents which had been discontinued across one or more sentences were all regarded re-introduced into the discourse. On a third tier, we had the RE type for a single reference with the main categories nominal, pronominal, zero anaphora, and classifier. Under nominal, we identified bare nouns, modified nouns, and fingerspelled nouns. For classifiers, we distinguished among three types of handshapes: WECL, BPCL, and ExtCL. Finally, we had CA,[7] agreement, plain tags for

[6] Only 4 participants (2 native, 2 late) narrated to the experimenter whereas the remaining narrated to the camera. We did not make it obligatory for participants to narrate to the digital camera or to the experimenter for few reasons. First, a native or native-like deaf experimenter was not always available, and a hearing late signer of TİD attended some sessions as the experimenter. Therefore, most signers preferred to narrate to the camera. Furthermore, some signers did not feel comfortable narrating to the camera and, as a result, narrated to the deaf research assistant, if available. We ran an additional model excluding the 4 signers who narrated to the experimenter and compared it with the original model including these signers (see Appendix C). The results imply that there is not much of a difference.

[7] Note that CA can also be further subdivided into overt, reduced, and subtle CA, following (Cormier et al., 2015). In overt CA, the signer is "fully in character" and does not use any other lexical or classifier constructions. In reduced CA, the signer can involve a small amount of narration or lexical material while tracking a referent using CA. However, subtle CA refers to cases where the referent is primarily tracked by a non-CA construction (e.g., nominal, pronominal, verbal or classifier constructions) but the signer subtly uses a few CA articulators at the same time (e.g., enacting the eye-gaze of the character). We only coded overt and reduced types as reference tracking by CA, and disregarded the subtle type. We'd also like to acknowledge that mixed CA, or simultaneous tracking of two or multiple references through CA and other tools can be possible (Dudis, 2004; Liddell, 2003). In such cases, as we explain here, we only coded only the subject of a clause for maintenance and re-introduction. If the referent was in subject position and tracked by using CA, we considered this an instance of CA, as well.

zero anaphora. We were unable to observe any instance of HCLs occurring in isolation (i.e., not part of CA). We should also highlight here that we coded referent status as nominal if the clause included an explicit nominal referent. For example, if constructed action, an index sign, or a classifier preceded or followed its explicitly signed nominal referent, the clause was regarded as having nominal reference (i.e., modified noun). The annotation tiers are presented in Table 1.

2.5. Data analysis

In our analysis, we use Bayesian regression models with the help of the brms package (Bürkner, 2018) in R. In a Bayesian regression the prior and the likelihood is used to calculate the posterior. Instead of a single filter of significance, we get a posterior probability distribution. We do not define our own priors and use the brms package defaults. We are using Bayesian regression to avoid some common pitfalls of other approaches (Kruschke, 2011; Wagenmakers, 2007).

For this particular type of experimental data, we fit the responses to a multinomial distribution. Most of the time, experimental results have yes/no-true/false responses which are fit to binomial distributions, reading/response times which are fit to log-normal distributions, and ratings which are fit to cumulative distributions. In these cases, the researcher is not particularly interested in the 'intercept' coefficient which shows the mean value of the response. The researcher is usually interested in the remaining coefficients which give information about predictor level comparisons. Each coefficient is a comparison. That is why for a predictor with two levels A and B, the plots or the results only have "A" or "B" as labels.

In a multinomial distribution, the responses are in a categorical relationship where the levels can be A, B, C, and more. These levels are not ordered in time, they are not cumulative, and they are not additive. If we were to make an analogy, they are like countries on Earth which can have differences and similarities, but they do not have to, and they are treated as distinct entities. In a multinomial distribution, one of the responses becomes the level of comparison and other levels are compared against it. In a way, there are multiple binomial distributions. However, the intercepts in a multinomial distribution end up having more of an interest for the researcher. This is because the intercept is a comparison of two levels of the response to the exclusion of the remaining response levels. There is another consideration that should go into interpreting the results of a multinomial distribution. Different from the intercepts, the remaining coefficients are predictor level comparisons within the grand comparison of the response levels. To indicate which predictor level comparison belongs to which response comparison, we name our coefficients with prefixes followed by an underscore.

In our model plots, we report median estimates as points, 50% credible intervals as a thick line and 95% credible intervals as a thin line. These numbers are relatively arbitrary, and they are intended to show the posterior probability distribution of the coefficients. We use interval plots to save space and have a more compact plot. If a considerable amount (>90%) of the posterior probability distribution is towards a sign (−/+) we interpret it as a categorial effect, if a good amount (>50%) of the distribution is towards a sign (−/+) we interpret it as a tendency, and we see the remaining distributions as indifference. In addition to these, we look at how the distribution is skewed in the extremes or how 'wide' it is from the median estimate to inform us mainly about uncertainty and variation.

3. Results

We collected 4007 data points as a result of the experiment. Each data point is a referent tracked by the participant. Each of the REs is classified in terms of its Discourse Status (Introduction, Maintenance, Re-introduction), its Type (Nominal, Pronominal, Classifier, Zero Anaphora),[8] and Participant Group (DoD, DoH).[9]

Across our acquisition groups, we observed 1031 (0.26) instances of referent introduction, 1589 (0.4) instances of referent maintenance, and 1387 (0.35) instances of referent re-introduction. For the introduction of a referent, the majority of the REs were nominal constructions (Table 2). However, we observed a sporadic use of classifiers and zero anaphora respectively. When the discourse status was maintained, signers extensively used zero anaphora to refer to the entities in the immediately previous clause. Classifier constructions followed zero anaphora in frequency in maintained contexts. We observed only a few instances of nominal use for referent maintenance. In re-introduction contexts, signers used a greater proportion of nominal markings which were followed by zero anaphora, classifier, and pronominal use.

Table 3 shows that for all discourse statuses the most numerous nominal type was bare nominal which was followed by nouns modified by index or classifiers. In number, signers used modified nouns more in introduction and re-introduction compared to maintenance settings. Signers produced a total number of 40 pronouns (Table 4). A great majority of the pronominal constructions were used to re-introduce a referent into the discourse. We observed only a very small amount of pronoun use for referent introduction and maintenance.

As for the classifier constructions (Table 5), WECL was the most common type, followed by BPCL and ExtCL. For the first mention of a referent, signers mostly preferred to use ExtCL. However, for referent maintenance and re-introduction WECL was used more compared to BPCL and ExtCL. Among the markers of zero anaphora, CA was most frequently employed, and it was followed by plain verbs and agreement verbs (Table 6). Overall, signers used very few markers of zero anaphora for the

[8] In our statistical analyses, we will not consider the subtypes of REs but rather group them by the four proposed main types (Nominal, Pronominal, Classifier, and Zero Anaphora). However, we allude to the numerical distribution of the subtypes in this and following sections.

[9] Similarly, we consider DoH signers a single group in our analyses and disregard the differing age of acquisition intervals (0–3, 4–7, 8–12, 13–17).

Table 2
Distribution of all discourse status by RE types.

	Introduced	Maintained	Re-introduced
Nominal:	92.7% (956)	5.9% (93)	63.7% (884)
Pronominal:	0.1% (1)	0.3% (4)	2.5% (35)
Classifier:	5.3% (55)	18.3% (291)	7.8% (108)
Null:	1.8% (19)	75.6% (1201)	26% (360)

Table 3
Distribution of nominals by discourse status.

	Bare Noun	Modified Noun	FS Noun
Introduced:	48.7% (813)	53% (134)	75% (9)
Maintained:	5% (83)	4% (10)	0% (0)
Re-introduced:	46.3% (772)	43% (109)	25% (3)

Table 4
Distribution of pronominals by discourse status.

	Pronominal
Introduced:	2.5% (1)
Maintained:	10% (4)
Re-introduced:	87.5% (35)

Table 5
Distribution of classifiers by discourse status.

	WECL	BPCL	ExtCL
Introduced:	2.2% (6)	2.5% (3)	70.8% (46)
Maintained:	67.5% (181)	77.7% (94)	24.6% (16)
Re-introduced:	30.2% (81)	19.8% (24)	4.6% (3)

Table 6
Distribution of zero anaphora by discourse status.

	Constructed Action	Plain Verb	Agreement Verb
Introduced:	1.6% (17)	0.3% (1)	0.5% (1)
Maintained:	71.5% (749)	89.3% (302)	76.9% (150)
Re-introduced:	26.8% (281)	10.4% (35)	22.6% (44)

introduction of a referent and the majority of the existing ones were CA. Additionally, signers used CA more for referent re-introduction than maintenance. We observed similar instances of agreement verbs for maintained and re-introduced contexts. In contrast, plain verbs were favored more in the maintenance setting than re-introduction.

Across the discourse statuses, there is also a difference between participant groups in the use of zero anaphora for reference tracking. DoD signers of TİD used it more frequently (0.22) compared to the DoH signers (0.17). Comparably, DoH signers used nominals more frequently (0.26) than DoD signers (0.22). Fig. 1 shows the numerical distribution of the responses by RE type and Group.

For more inference on the data and having pairwise comparisons, we fit a regression model to RE Type using discourse status and acquisition group as predictors. We used the brms package (Bürkner, 2018) in R, with a categorical distribution on the responses and sum contrasts for the predictors Discourse Status (Introduction, Maintenance, Re-introduction) and Participant Group (DoD, DoH). As the overall number of produced pronouns was very little (40 data points), we excluded pronominal use from the following analyses. For the current analysis, we did not define priors ourselves and used the preset uninformed priors. Fig. 2[10] shows the posterior probability distributions where the dot is the median estimate, the thick line is the 50% credible intervals, and the thin line is the 95% credible intervals. There are 3 responses we are considering in this model. They are Classifier, Nominal, and Zero Anaphora. Classifier response is the level that other responses Nominal and Zero Anaphora are compared against.

[10] The regression model results are given in Appendix D. We ran another model where we used the self-reported acquisition time as a predictor with 3 levels 0–3:Early, 4–7:Late1, and 7-above:Late2. However, our model did not converge properly and the credible intervals were very wide spread, yielding the results uninformative. We provide the model results as a plot in Appendix E.

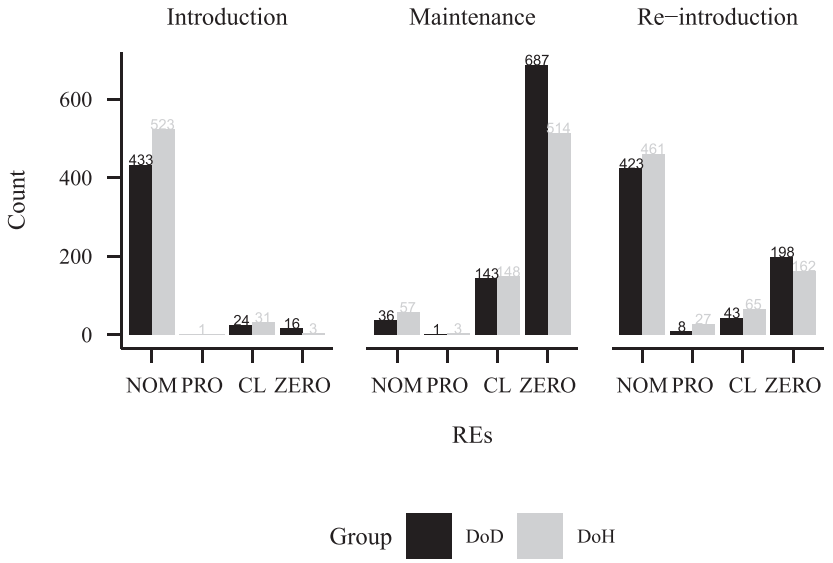


Fig. 1. Referent counts by Discourse Status (Introduction, Maintenance, Re-introduction), RE Type (Nominal, Pronominal, Classifier, Zero Anaphora), and Participant Group (DoD, DoH).

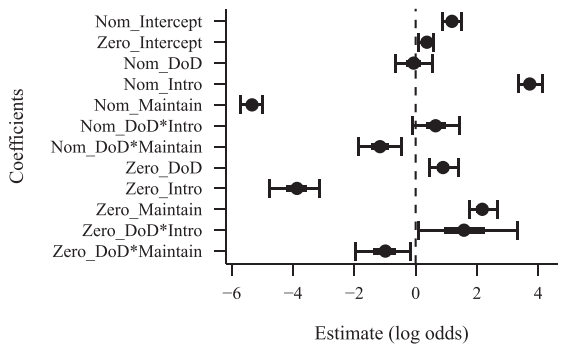


Fig. 2. Regression model plot for the RE Type (Nominal, Zero, Classifier) with the predictors Discourse Status (Introduction, Maintenance, Re-introduction) and Participant Group (DoD, DoH).

In a multinomial distribution, the model takes one of the responses as a reference and compares all other responses to it. For example, the first coefficient, Nom_Intercept (nominal intercept), in Fig. 2 is the comparison of a nominal versus a classifier. It means that participants produced more nominals than classifiers in general regardless of participant group and discourse status. The second coefficient shows that zero anaphora was also used more than classifiers by the participants in general, but not as much as nominals.

In the comparison of nominals and classifiers, acquiring TİD from deaf signing caregivers did not have an effect. Nominals were used more when the discourse status was introduction compared to re-introduction. Again, the whole comparison is made against a classifier. In contrast to the introduction status, nominals were used less in maintenance contexts compared to the re-introduction contexts within the greater comparison to classifier referents. There seems to be an interaction between the introduction status of discourse and being a DoD signer of TİD. When the acquirer is a DoD signer and the discourse function is introduction, the chances of observing a nominal referent gets higher.[11] Also, there seems to be an interaction

[11] Remember that this is an interaction term and the grand comparison is nominal vs classifier use.

between maintaining a referent and being a DoD signer of TİD. When it was a DoD signer of TİD and the discourse context was maintenance, the chances of observing a nominal referent gets lower.[12]

Compared to classifiers, being a DoD signer of TİD increased the odds of using zero anaphora in general. Zero anaphora constructions were used less in introduction contexts than in re-introduction. This contrasts with the nominals (4th coefficient) as they were used more in referent introduction versus re-introduction. In contrast to introduction contexts, zero anaphora was used more in referent maintenance compared to re-introduction, yet again within the greater comparison to the classifiers. There seems to be an interaction between introducing a referent and being a DoD signer of TİD. In that, the odds of using zero anaphora increases if the participant is a DoD signer of TİD and the referent is used in an introduction context. There is another interaction with regards to referent maintenance, contrasting the first interaction. In that, the odds of using zero anaphora decrease if the participant is a DoD signer of TİD and the referent is maintained. This does not mean that DoH signers used more zero anaphora in maintenance contexts. It means that the use of zero anaphora did not linearly increase as the sum of using a zero anaphora marker as a DoD signer plus using zero anaphora for maintaining a referent versus re-introducing it.

4. Discussion

In our study, we aimed to (i) describe how signers track referents in signed discourse in TİD and (ii) examine whether late acquisition of TİD results in more over-redundant referent selection. To this end, we investigated the distribution of referring expressions (REs) that the DoD and DoH signers select when employing referents in different discourse statuses (introduced, maintained, and re-introduced).

Regarding referent tracking strategies, we had the general expectation that signers would use more explicit forms (mainly nominals) for referent introduction and less implicit forms such as zero anaphora, pronominals, and classifiers for maintenance. In re-introduced contexts, we predicted that signers would use both explicit and implicit markers depending on the accessibility of the tracked referent.

Especially, for age of acquisition effects, based on what is proposed for child and adult deaf signers with delayed language exposure in terms of their morphosyntactic (Boudreault and Mayberry, 2006; Cormier et al., 2012; Kayabaşı and Gökgöz, 2022) and narrative development (Becker, 2009; Cormier et al., 2013), we expected that DoH signers would be more over-redundant in their referent tracking, perhaps akin to second language learners (Bel et al., 2015; Frederiksen and Mayberry, 2019). That is, we had the expectation that DoH signers would use more explicit markers like nouns and fewer implicit markers like zero anaphora even for highly accessible referents (when the discourse status is maintained or even re-introduced in same cases) than DoD signers.

4.1. Tracking referents in TİD

Mainly, the results of the present study support our initial set of hypotheses. In line with our expectations, regardless of the participant groups (DoD or DoH) (i) signers mainly used nominals to introduce a referent into the discourse, (ii) used zero anaphora and classifiers but not pronouns for maintained contexts, and (iii) employed both nominals and less explicit markers (classifiers, zero anaphora and pronouns) to re-introduce a referent.

By contrast, the proportion of the observed discourse statuses (26% for introduction, 40% for maintenance, 34% for re-introduction across acquisition groups) in this study differed from that of some other studies. For a comparison, while the percentage of introduced referents were similar in both research (26% versus 24%), the participants in the present study brought back referents into the discourse more frequently compared to the participants in Frederiksen and Mayberry (2019) and Frederiksen and Mayberry (2016) which reported that re-introduction contexts accounted for only 7% of the referents in ASL. On the other hand, maintenance percentages were lower in the present study compared to Frederiksen and Mayberry (2016) (40% versus 69%). Investigating the distribution of REs across discourse statuses in ASL, a similar study by Czubek (2017) also reported contrasting numbers (17% for introduction, 64% for maintenance, and 19% for re-introduction). We suggest that the discrepancy might be due to the nature of the stimuli. In Frederiksen and Mayberry (2016), the authors used a 4-6-episode-long picture story with 2 animate characters and 1 inanimate object. In contrast, the stimuli in the present study consisted of 8-episode-long video clips on average with a mean number of 2 animate characters and 3 inanimate objects. Although the number of animate characters and inanimate characters in Czubek's (2017) stimuli matched that of the present study, their narrative structure (a 6-episode-long picture story) was still shorter compared to our narrative stimuli. We believe fewer possible referents and/or a simpler narrative structure in these studies may have contributed to the lower number of re-introduced contexts compared to the present study. Due to the story length and composition in this study, the participants had to track more recurring animate or inanimate referents for a longer period of

[12] This coefficient too is an interaction term and needs to be considered withing the comparison of nominal versus classifier use.

time. As a result, our participants might have engaged in referent re-introduction more than what was reported in previous studies (Czubek, 2017; Frederiksen and Mayberry, 2016).

As for the distribution of REs across different discourses statuses, we observed that signers overwhelmingly preferred to use nominals over other REs for the first mention of a referent and used zero anaphora such as CA, agreement and plain verb for referents with high accessibility (i.e., when the discourse status was maintained). This finding parallels other accounts of referential accessibility suggested for other sign languages (see Frederiksen and Mayberry (2016); Czubek (2017); and Swabey (2002); for ASL, Morgan (2005); for BSL Bel et al. (2015); Barberà and Massó (2009) for LSC; Ferrara et al. (2022) for other sign languages). Our results also indicate that modified nouns (e.g., nouns that are preceded or followed by a classifier or IX) appeared more in introduced contexts compared to re-introduced contexts. This indicates that modified nouns are used more to track referents with lower accessibility, probably due to their more explicit structure.

Yet, surprisingly, the signers in this study used pronominal IX very sporadically with only 40 observed instances that were mainly used to re-introduce referents rather than maintain them. This finding is comparable with what has been reported for ASL (Czubek, 2017; Frederiksen and Mayberry, 2016; Swabey, 2002) but not with LSC (Bel et al., 2015), BSL (Morgan, 2005) and DGS (Perniss and Özyürek, 2015), in which the signers extensively made overt pronominal references (up to 30%) to maintain entities. Comparable to our findings, it has been reported that pronouns do not frequently occur in the local context and instead follows a topic shift and thus rank higher than classifiers and zero anaphora (see Barberà and Massó, 2009 for LSC; and Nuhbalaoglu, 2018 for TİD). Considering this, the claim that the IX sign functions like demonstratives that are also used to track referents in re-introduced contexts has not been borne out (Koulidobrova and Lillo-Martin, 2016). Similar to these research, our findings indicate that the pronominal IX in TİD was used more concurrently with nominal constructions and pronominal IX was used very infrequently in isolation. The observation that overt pronouns are rare in ASL narratives comes from studies that include a simple picture retelling task with one protagonist (e.g., Frederiksen and Mayberry, 2016) as well as a more complex narrative design as in (Czubek, 2017). However, Czubek (2017) also incorporated different genres and reported more instances of overt pronouns in personal narratives (compared to picture or video retelling). In fact, this finding suggests that the use of pronouns might be genre-dependent. Moreover, another production study on referent tracking in ASL reported object preference for pronominals (Frederiksen and Mayberry, 2017). However, we only coded subjects for maintained and re-introduced referents. We argue that all of these factors (genre-dependency as well as object preference) might contribute to the explanation of why overt pronouns in our data are dispreferred in favor of other markers for highly accessible referents such as zero anaphora and classifiers.

Regarding the allocation of classifier handshapes, we found that WECLs were the most common type of classifiers for the maintenance of a referent followed by BPCLs and ExtCLs. We observed a similar distribution for re-introduced contexts. In contrast, a great number of the overall ExtCLs were used to introduce a new referent into the discourse. That is to say, whereas WECLs were the preferred classifier types to signal highly accessible referents, ExtCL constructions were mainly used for referents which were not easily accessible. We suggest that the less iconic and transparent nature of WECLs allowed signers to continue a previous referent without having to use an explicit form. As pointed out by Czubek (2017), signers prefer to rely on ExtCLs for the first mention of an entity because these constructions are informative and explicit by nature, and they provide visual and descriptive cues about an entity and its location in space. We only observed 3 instances of ExtCLs for re-introduced contexts, replicating Frederiksen and Mayberry's (2019) findings for ASL.

As for the distribution of the zero anaphora, approximately 90% of the plain verbs were used to maintain a previous referent and this makes these constructions least implicit REs used for TİD.[13] Agreement verbs and CA were the following implicit markers of reference, 0.77 and 0.72 of which were used for maintained contexts, respectively. This contrasts with some of the research (Czubek, 2017) in which agreement verbs ranked lowest on the scale, indicating that these constructions were more implicit compared to plain verbs. However, there seems to be a common ground for the position of CA markers which have been claimed to rank higher than other markers of zero anaphora as in the present study (Barberà and Massó, 2009; Czubek, 2017; Frederiksen and Mayberry, 2016). In Fig. 3, we report the distribution of REs in TİD as a function of referent accessibility and compare our accessibility hierarchy with that of (Frederiksen and Mayberry, 2016) for ASL. In the hierarchies, the leftmost REs (e.g., modified and bare nouns for TİD) are used when the accessibility is low. If the referent is already active in the addressee's mind and its accessibility is high, then the rightmost markers (e.g., agreement and plain verbs for TİD) are selected.

[13] As in other sign languages, in TİD, the lexical meaning of signs has an effect on the morphological grouping. For instance, usually (di)transitive agreement verbs denote some sort of physical or metaphorical transfer of an object or abstract notion (Meir, 1999). As for plain verbs, both phonology of a sign and its semantics have an effect on morphology. For instance, EAT in TİD is signed nearby the mouth and since it needs to remain in that phonological location, it is not suitable for agreement and thus it is regarded as a plain verb. Likewise the experiencer verb LOVE is signed on the torso and as such it does not take part in agreement. These generalizations noted we should also be cautious in labelling a verb as categorially one type or the other. For instance, some intransitive plain verbs like FALL or JUMP in TİD may display spatial person agreement with the single argument in the clause (Gökgöz and Sevgi, 2020). See Lourenço and Wilbur (2018) also for a similar discussion in Brazilian Sign Language.

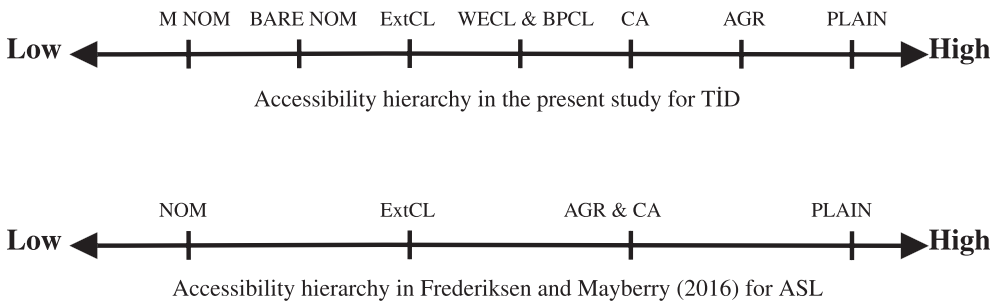


Fig. 3. Comparing the present study and Frederiksen and Mayberry (2016) in terms of proposed accessibility hierarchies.

Keep in mind that both hierarchies illustrated in Fig. 3 treat nominals and ExtCLs as markers of lowly accessibly referents. In both hierarchies, as markers of highly accessible referents, different types of zero anaphora markers are further distinguished. Plain verbs rank the lowest on the scales, preceded by agreement verbs and CA. On a similar ground, both scales lack pronouns, which occurred very infrequently in the data. Although Frederiksen and Mayberry (2016) did not include other classifier types in the hierarchy, we propose that WECLs and BPCLs must rank higher than zero anaphora but lower than ExtCLs that were mainly used by interlocutors to introduce a referent into the discourse context.

4.2. Effect of native acquisition on referent tracking

Likewise, our results only partly support the second set of hypotheses that we set for the effects of having signing deaf parents on participants' RE selection. That is, while being a DoD signer of TİD increased the odds of using zero anaphora in reference tracking across different discourse statuses, we failed to find a difference for overall nominal production. Taking a closer look at the interaction terms, we observed that DoD signers, compared to DoH signers, were less likely to use nominal constructions when the discourse status was maintained. Native acquisition from deaf caregivers further increased the odds of zero anaphora when the discourse status was introduced. However, we found the opposite alignment for the interaction of maintenance and native acquisition. That is, the coefficient for this interaction term slightly decreased the combined main effects of having a maintained context and being a DoD signer. This means that these main effects were greater than the interaction or added effects, pointing out to the implication that the type of discourse status (introduced, maintained, re-introduced) accounts for the distribution of REs in TİD narratives better than native acquisition from deaf caregivers (DoD, DoH) which, in comparison, had a less salient effect.

It can be observed that while DoH signers were only partially over-redundant in maintained contexts, they were more so in introduced contexts. In line with our study, a tendency for limited over-redundancy has been suggested for late signing children in DGS (Becker, 2009) and late signing adults in BSL specifically for the use of CA (Cormier et al., 2013). As for TİD, to our knowledge, there is only one study (Gür, 2018) that directly aimed at examining age of acquisition effects on adult signers' narrative skills. Gür (2018) observed that late signing deaf adults and children set the scene less frequently and used CA less accurately compared to their native counterparts. However, this particular investigation did not present any data on the distribution of REs between two acquisition groups. In the present study, the finding that DoD signers preferred to use null arguments even for the first mention of a referent (19 in total) is surprising given some of the previous literature in the topicality and saliency framework (Cormier et al., 2013; Ferrara et al., 2022; Swabey, 2002). These research reported very little or no use of zero anaphora by DoD signers for introduced contexts.

Given the paucity of research directed at the DoH or late signing group, we now turn to the referent tracking strategies observed for second language learners of a sign language. Our study replicated some of the findings of the line of research that investigated second language learners of a sign language (Bel et al., 2015; Frederiksen and Mayberry, 2019). The authors reported that more instances of zero anaphora in the context of referent introduction was attested for DoD signers than second language learners. Although using zero anaphora to introduce a referent into the discourse would normally result in referential ambiguity, it is important to note that our stimuli consisted of 10 interconnected narratives with 2 or more recurring characters. It may be possible that DoD signers, having already introduced the referent with an explicit nominal marker in a different discourse context, found it felicitous to refer to the same entity with more implicit markers in the following narratives even for introduced contexts. Then, our results imply a difference in pragmatic sensitivity to referential accessibility between DoD and DoH signers, which is more robustly reflected in introduced contexts. To test this implication, one could use the same number and length of stimuli from different cartoons with different characters and see if the tendency to introduce a referent without an overt nominal for the first time is dependent on the task or not.

In other contexts, we found only very small differences between the two participant groups. This means that adult signers with late exposure to sign language in our study were still able to achieve native-like competency in terms of

reference tracking in simple narratives. Nevertheless, DoD and DoH signers still exhibit some differences especially in terms of pragmatic sensitivity to economy of form despite using TİD as their preferred communication language for similar numbers of years. Since we only observed a small difference between the two acquisition groups for the use of certain REs, the aforementioned findings allude to the implication that the effect on native acquisition on pragmatic factors should also be considered in different contexts. For one, both groups of signers can be tested with different genres of narratives and with a more complex story design. In order to capture possible variation in the accessibility levels of re-introduced referents, a more fine-tuned protocol (as in Toole, 1996) can be used for measuring referent distance and the number of other possible competitors. Furthermore, our focus in this study was to look at referent tracking strategies between DoD and DoH signers. However, for future research, it might also be useful to look at pre and post-lingual acquisition of TİD. We only had 3 post-lingual signers of TİD.[14]

5. Conclusion

The present study aimed to investigate the reference tracking strategies in TİD narratives and whether native and late deaf TİD signers differ from each other in these strategies. In line with our expectations, we found that the distribution of REs (nominal, pronominal, classifier, and zero anaphora) followed from previous accounts of saliency and referential accessibility. For introduced contexts, signers produced more nominals and ExtCLs, and to maintain a previous referent, they mainly used null arguments (in clauses with CA, agreement and plain verbs) and certain classifiers (e.g., BPCL and WECL) to track highly accessible referents. We observed only very few instances of pronouns (mostly produced by DoH signers), unlike our expectations. The ones we observed were mostly reserved for re-introduced contexts along with nominals. Based on our findings across the two groups, we proposed a hierarchy of referent accessibility for TİD. As for the effects of native acquisition, we observed limited over-redundancy for signers with delayed language acquisition (i.e., DoH signers) who employed fewer implicit forms of reference tracking compared to DoD signers. DoD signers were less likely to use a nominal for maintained contexts and more likely to use zero anaphora for introduced contexts than DoH signers.

We conclude that DoH signers have overall native-like competency in simple narratives, however, following Swabey (2002)'s intuition, our findings also suggest that DoD signers adhere to pragmatic norms and leverage accessibility better than DoH signers to a certain extent (given our finding of limited overexplicitness for DoH signers) since they use less form when the referent is more active in the mind. To avoid this possible discrepancy between the groups, our results accentuates the necessity of engaging in signed narrative production early in life as well as the importance of early intervention for DoH or late signing deaf children. This is especially a crucial message for policymakers, educators, and health professionals who work with deaf and hard-of-hearing children. Providing early and effective access to sign language from very early on can help bridge the gap and ensure equal opportunities for language development and success in life for DoH signers.

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Declaration of competing interest

None.

Data availability

We have made the data and code available on this link: https://osf.io/4hmtc/.

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[14] When we looked at the random effects by participants, they did not differ from their acquisition group (DoD or DoH).

Appendix A. Participant background information

Table A.7
Participant demographic information based on self-report.

No	Status	Sex	AOA	Age	LOE	Deaf schools	Home language
2	DoD	M	0–3	33	12	PS, MS, HS	TİD, home sign
3	DoD	F	0–3	27	12	PS, MS, HS	TİD, home sign
*13	DoD	F	0–3	27	12	PS, MS, HS	Home sign
14	DoD	M	0–3	29	12	PS, MS, HS	TİD, home sign
18	DoD	M	0–3	28	12	PS, MS	TİD
20	DoD	M	0–3	32	12	PS, MS	TİD
22	DoD	M	0–3	35	12	PS, MS, HS	TİD
24	DoD	F	0–3	23	12	PS, MS, HS	TİD
26	DoD	F	0–3	30	12	PS, MS, HS	TİD
27	DoD	F	0–3	25	12	PS, MS	TİD
29	DoD	F	0–3	24	14	PS, MS, HS	TİD
30	DoD	M	0–3	18	12	PS, MS	TİD
33	DoD	F	0–3	21	16	PS, MS, HS	TİD
34	DoD	M	0–3	19	16	PS, MS, HS	TİD
38	DoD	F	0–3	25	12	PS, MS	TİD
*10	DoH	F	4–7	35	14	PS, MS	TİD, home sign, TR
23	DoH	M	4–7	36	12	MS, HS	TR, home sign
4	DoH	M	4–7	33	12	PS, HS	TR
16	DoH	F	4–7	33	12	PS	TR, home sign
21	DoH	F	4–7	31	14	PS, MS	Home sign
25	DoH	M	4–7	35	12	PS, MS, HS	Home sign
35	DoH	F	8–12	49	8	PS, MS	Home sign, TR
36	DoH	M	8–12	43	16	PS, MS	TR
12	DoH	M	8–12	28	16	MS	TR
15	DoH	F	8–12	24	12	PS, MS, HS	TR
19	DoH	F	8–12	24	8	PS, MS	Home sign
28	DoH	M	8–12	33	12	PS, MS	Home sign
31	DoH	M	13–17	50	8	MS	TR, home sign
32	DoH	M	13–17	31	16	PS, MS, HS	TR

Note. AOA = age of acquisition, LOE = level of education, PS = primary school, MS = middle school, HS = high school, TR = (Spoken) Turkish. *We excluded Participant 13 from our data analysis because the signer indicated to have deaf parents, thus grouped as DoD, but also reported only home sign as the home language and not TİD. Since our classification of DoD included the criterion of having deaf and TİD-signing parents, we decided to remove this participant's data. Also, Participant 10 reported to use TİD at home despite having hearing caregivers which may go against our classification criterion for being DoH that is to have non-signing hearing caregivers. However, Participant 10 informed us that the parents used very rudimentary sign language and that they often did not understand what he was signing.

Appendix B. Episodes in the stimuli

Narration 1

1. Tom chases Jerry, wearing a wooden plank
2. Tom and Jerry enter a tube
3. Tom falls down and Jerry runs away
4. Tube gets thinner and Tom chases Jerry
5. Jerry gets out and escapes
6. Tom follows Jerry in shape of a stick

Narration 2

1. Tom walks past a female cat sitting on a couch
2. Tom turns to and approaches female cat
3. Female cat blushes
4. Tom offers a fish in aquarium to female cat
5. Female cat rejects offer
6. Tom offers a bird in cage to female cat
7. Episode 5 is repeated
8. Tom leaves by walking in a flirtatious manner

Narration 3

1. Jerry falls down and tries to walk up stairs
2. Tom pulls carpet back
3. Jerry struggles
4. A piano falls down stairs
5. Jerry manages to escape
6. Tom sees piano and tries to run away
7. Piano smashes into Tom and flattens him
8. Tom falls on ground

Narration 4

1. Tom hides behind a cardboard house
2. Jerry walks to house with a toy mouse
3. Toy leaves Jerry who stops at entrance
4. Toy enters house
5. Toy gets smashed into pieces
6. Jerry is surprised
7. Tom hurts his stomach after swallowing toy
8. Tom looks at his broken teeth on a mirror
9. Tom gets angry and throws down mirror

Narration 5

1. Tom fakes sleeping and suddenly gets up
2. Tom pulls a rope inside a couch
3. Jerry appears holding a bar of soap
4. Jerry washes Tom's mouth with bar and flees
5. Tom spits soap out
6. Jerry escapes to nest with rope
7. Tom catches rope and stars pulling it
8. A mouse trap appears and catches Tom's nose
9. Tom yells and removes trap

Narration 6

1. Tom points a sword at Jerry and catches him
2. Tom looks at Jerry
3. Red spots appear on Jerry's face
4. Tom gets scared and drops Jerry
5. Tom rushes into bathroom
6. Tom washes his hands
7. Tom opens a drawer
8. Tom swallows pills one after another
9. Feeling ill, Tom looks out of window
10. Tom and Jerry look at each other

Narration 7

1. Two male cats chase one another
2. Tom sees a female cat and kisses her
3. Tom hides away when black cat returns
4. Tom pokes his head behind couch again
5. Episode 3 is repeated
6. Black cat sees female cat and hugs her
7. Tom appears and black cat kisses Tom
8. Two male cats move away from one another

Narration 8

1. Jerry hits Tom's knee with a hammer
2. Tom suddenly jumps up
3. Tom yells and holds his knee
4. Jerry approaches Tom holding a thermometer
5. Jerry sticks thermometer into Tom's mouth
6. Jerry lights a fire under thermometer
7. Red liquid starts to rise up
8. Thermometer explodes

Narration 9

1. Tom sits on Jerry who tries to get loose
2. Jerry looks around and sees a hat ribbon
3. Jerry finds a needle attached to hat
4. Jerry takes needle and sticks Tom with it
5. Tom turns red and jumps
6. Jerry places needle between two cushions
7. Tom dodges needle

Narration 10

1. Wearing a stethoscope, Tom catches Jerry
2. Jerry yells into stethoscope
3. Tom's head pops up
4. Jerry runs and enter a mouse nest
5. Tom inserts a gun into nest
6. Gun bends over toward Tom
7. Tom fires gun and his head explodes

Appendix C. Effect of narrating to the camera vs. experimenter

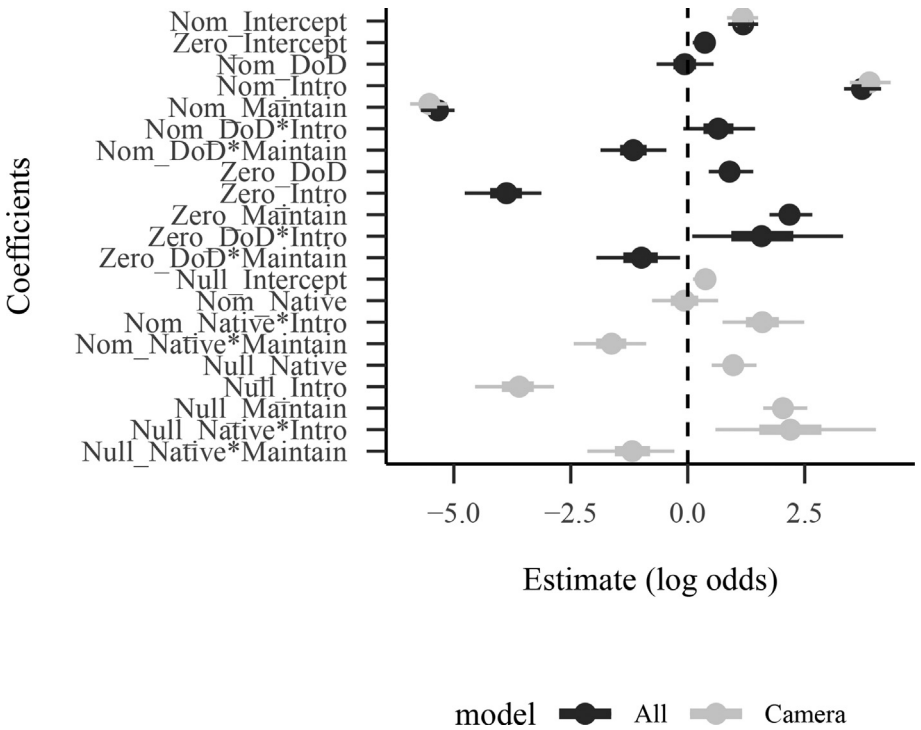

Fig. C.4. Regression model plot for the RE Type (Nominal, Null) with the predictors Discourse Status (Introduction, Maintenance, Re-introduction), Participant Group (Native, Late) and Narration Style (all responses vs. only camera). Note: "All" indicates model results including all participants (both camera and experimenter) whereas "camera" indicates the results from only those who narrated to the camera. That is, the 4 signers who narrated to the experimenter were from analysis in the second dataset.

Appendix D. Regression model results for RE Type

Table D.8
Regression model results for the RE Type (Nominal, Zero, Classifier) with the predictors Discourse Status (Introduction, Maintenance, Re-introduction) and Participant Group (DoD, DoH).

Coefficients	Outer width	Inner width	Point estimate	ll	l	m	h	hh
Nom_Intercept	0.90	0.50	median	0.86	1.06	1.18	1.31	1.50
Zero_Intercept	0.90	0.50	median	0.11	0.26	0.37	0.46	0.59
Nom_DoD	0.90	0.50	median	−0.67	−0.31	−0.06	0.18	0.55
Nom_Intro	0.90	0.50	median	3.34	3.56	3.72	3.88	4.13
Nom_Maintain	0.90	0.50	median	−5.70	−5.49	−5.34	−5.20	−4.98
Nom_DoD × Intro	0.90	0.50	median	−0.09	0.34	0.65	0.98	1.44
Nom_DoD × Maintain	0.90	0.50	median	−1.86	−1.45	−1.16	−0.88	−0.46
Zero_DoD	0.90	0.50	median	0.45	0.72	0.89	1.10	1.40
Zero_Intro	0.90	0.50	median	−4.77	−4.22	−3.87	−3.55	−3.13
Zero_Maintain	0.90	0.50	median	1.75	1.99	2.17	2.37	2.66
Zero_DoD × Intro	0.90	0.50	median	0.10	0.93	1.58	2.26	3.32
Zero_DoD × Maintain	0.90	0.50	median	−1.95	−1.38	−0.99	−0.64	−0.17

Appendix E. Additional model with 3 levels for Nativeness

Table E.9
Model results for Nativeness with 3 levels.

Coefficients	Estimate	Est. error	Lower 95	Upper 95	Rhat
Nom_Intercept	1.24	0.21	0.83	1.68	1.00
Null_Intercept	−4.77	4.19	−16.09	0.09	1.01
Nom_Late1 vs Native	0.43	0.57	−0.71	1.56	1.00
Nom_Late2 vs Late1	−0.34	0.51	−1.32	0.68	1.01
Nom_Intro	3.76	0.26	3.27	4.27	1.00
Nom_Maintain	−5.24	0.22	−5.67	−4.80	1.00
Nom_L1 vs N × Intro	1.05	0.67	−0.23	2.41	1.00
Nom_L2 vs L1 × Intro	−0.07	0.67	−1.41	1.22	1.00
Nom_L1 vs N × Maintain	−0.35	0.57	−1.49	0.75	1.00
Nom_L2 vs L1 × Maintain	−0.87	0.54	−1.89	0.20	1.00
Null_Late1 vs Native	−15.00	12.57	−48.88	−0.48	1.01
Null_Late2 vs Late1	15.88	12.57	1.30	49.79	1.01
Null_Intro	−24.10	16.74	−69.41	−4.68	1.01
Null_Maintain	12.30	8.37	2.60	35.02	1.01
Null_L1 vs N × Intro	−60.77	50.28	−195.99	−2.68	1.01
Null_L2 vs L1 × Intro	61.91	50.26	3.62	197.45	1.01
Null_L1 vs N × Maintain	29.89	25.14	0.81	97.46	1.01
Null_L2 vs L1 × Maintain	−30.89	25.13	−98.46	−1.73	1.01

Note. Rhat values above 1 indicate that the regression model chains did not converge properly. There were 4 chains in our regression model.

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