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ARTICLE

Prosody of focus in Turkish Sign Language

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Abstract
Prosodic realization of focus has been a widely investigated topic across languages and modalities. Simultaneous focus strategies are intriguing to see how they interact regarding their functional and temporal alignment. We explored the multichannel (manual and nonmanual) realization of focus in Turkish Sign Language. We elicited data with focus type, syntactic roles and movement type variables from 20 signers. The results revealed the focus is encoded via increased duration in manual signs, and nonmanuals do not necessarily accompany focused signs. With a multichanneled structure, sign languages use two available channels or opt for one to express focushood.

Keywords: duration; manual prosody; multichannel; nonmanual; prosody of focus; simultaneity; Turkish Sign Language

1. Introduction

Information structure is about the strategies used by interlocutors to manage and package messages. The Common Ground, content shared by the interlocutors (Chafe, 1976), is continuously updated as part of Common Ground Management (Krifka, 2008) to optimize the message. Interlocutors can shape the Common Ground via focus that introduces the alternatives (Krifka, 2008; Rooth, 1992), thus affecting the unfolding of the exchange. To illustrate, the subject in (1) and the object in (2) bear focus affecting the continuation of the discourse by the alternatives introduced by them. They also indicate the highlighted locus of the sentences as indicated by capitalization. When the same lexical items are mapped onto different information packaging in question-answer contexts, as indicated in (1) and (2), the answers with their specific prosodic properties are no longer interchangeable.

(1) A: Who is eating a banana?
B: [ECE] is eating the banana.

(2) A: What is Ece eating?
B: Ece is eating [the BANANA]

During this exchange, interlocutors can use various tools simultaneously to convey focus, but these simultaneous strategies can be shaped differently in spoken and sign languages. As presented in Figure 1, in spoken languages, the same information can be conveyed via the simultaneous realizations of two modalities: aural-auditory, where the speech channel is active, and visual, where the gesture channel is active. In sign languages, simultaneity is built via the activation of two channels – manual and nonmanual – in the visual modality. In terms of focus marking, in both spoken and sign language literature, two overarching patterns have been observed regarding the organization of simultaneity: (i) all the available channels encode the same semantic/pragmatic and prosodic function via two modalities in spoken languages or a single modality in sign languages, or (ii) two channels have distinct functions in that there is a division of labor.

The first pattern is found to be used extensively in spoken languages. In spoken languages that use oral-auditory modality, prosodic cues such as height or timing of fundamental frequency (f0), duration and intensity are essential in the production and perception of focus. Studies have further shown that speakers also use multimodal strategies, that is, gestures may align with these prosodic cues or the prosodic structure (Bergman et al., 2014; Dohen et al., 2006; Esteve-Gibert et al., 2017; House et al., 2001; Loehr, 2012; Prieto et al., 2015; Turk, 2020; Wagner et al., 2014). In a perception study, Prieto et al. (2015) found that speakers could detect contrastive

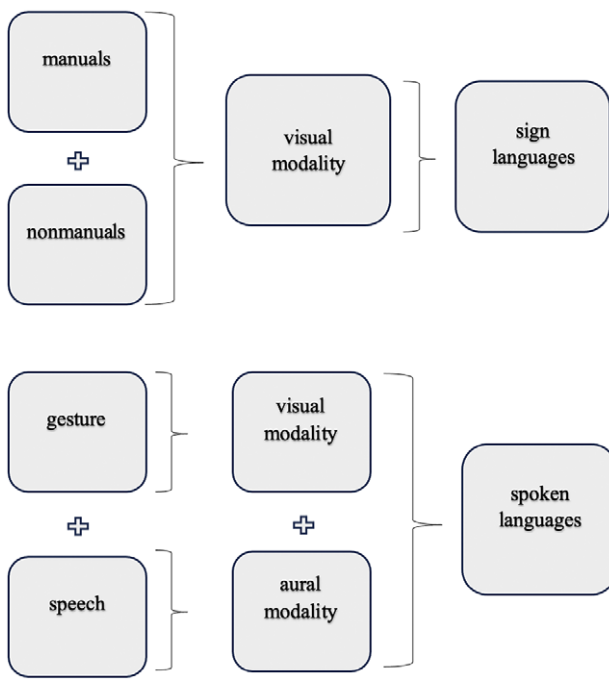

Figure 1. The multimodal and multichannel structure in spoken and sign languages.

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focus more accurately when the target stimuli are presented with the widest pitch range and highly activated gestures, that is, head nodding, eyebrow raising, indicating that speech prosody and visual prosody go hand in hand. In a production study, Dohen et al. (2006) revealed that contrastive focus is lengthened and hyper-articulated via articulatory features such as movements of the inter-lip area and protrusion. Additionally, contrastive focus is accompanied by a head nod and eyebrow movements, but the gestures' appearance shows inter and intra-speaker variation. These findings reveal that spoken languages can encode focus via multi-modal prosody based on oral-auditory modality and visual-gestural modality as illustrated in Figure 1.

Sign languages, using visual-gestural modality with a layered structure of manual and nonmanual articulators, either use both channels or a single channel. Studies investigating information structure in sign languages have shown that signers use modulations in manual signs in the manual channel (Kimmelman, 2014; Schlenker et al., 2016; Van der Kooij et al., 2004), and face, head or body movements in the nonmanual channel (Kimmelman, 2014; Puupponen et al., 2015; Schlenker et al., 2016; Wilbur, 2000a). In contrast to the studies on spoken languages, in sign languages, how the manual and nonmanual channels contribute to each other is still under discussion. In the literature, nonmanual prosody is suggested to mark intonation, and manual prosody marks the boundaries of prosodic constituents (Brentari & Fenlon, 2020; Brentari et al., 2015; Dachkovsky & Sandler, 2009; Nespor & Sandler, 1999; Sandler, 1999, 2012).[1] This classification signals the division of labor for the two available channels. In this regard, a few studies investigated how the prosody of manual signs is modulated for focus marking along with the nonmanuals. Increased amplitude, speed acceleration and longer hold times along with nonmanuals were observed in American Sign Language (ASL)[2] and French Sign Language (LSF) (Schlenker et al., 2016). Similarly, Sign Language of the Netherlands (NGT) signers were found to modulate the sign speed, size and duration in the manual channel while simultaneously using the nonmanuals (Kimmelman, 2014; Van der Kooij et al., 2004). These findings illustrate that manual and nonmanual channels go hand in hand to express prominence. Similar strategies in the manual channel were also observed in Russian Sign Language (RSL), but nonmanuals did not necessarily accompany the focused items (Kimmelman, 2014). Thus, RSL shows typologically distinct patterns than other reported sign languages in terms of how the simultaneity of manual and nonmanual channels are organized in the visual modality. While both manual and nonmanual channels in NGT, ASL and LSF express focus, only the

[1]As a side note, the same researchers suggest that the same manual and nonmanual strategies can also appear in other components of grammar, such as syntax. Hence, it is still under discussion whether the nonmanuals are within the phonological, morphological, syntactic, semantic/pragmatic or prosodic domains or any combinations of these domains. See Wilbur (2021) for a detailed discussion.

[2]The abbreviations used in this study are ACC, accusative; ASL, American Sign Language; br, brow raise; CF, contrastive focus; DAT, dative; DGS, German Sign Language (Deutsche Gebärdensprache); DoD, deaf children of deaf adults; DoH, deaf children of hearing adults; F0, fundamental frequency; FinsL, Finnish Sign Language; FOC, focus; hn, head nod; hs, head shake; IP, intonational phrase; LSF, French Sign Language; NGT, Sign Language of the Netherlands; NMM, nonmanual marker; NP, noun phrase; O, object; PW, prosodic word; ÖGS, Austrian Sign Language (Österreichische Gebärdensprache); PF, presentational focus; PhP, phonological phrase; PJM, Polish Sign Language (Polski Język Migowy); RSL, Russian Sign Language; S, subject; SG, singular; TİD, Turkish Sign Language (Türk İşaret Dili); TOP, topic; V, verb; VP, verb phrase.

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manual channel conveys prominence in RSL, which can be analyzed as a division of labor. Note that the manual prosodic pattern in RSL does not conform with the classification suggested in the literature in that it is the manual prosody that encodes focus intonation, not the nonmanual prosody.

Building on these findings and discussions in the literature, this study investigates manual and nonmanual prosodic cues used in Turkish Sign Language (TİD) to mark information structure, with a particular emphasis on focus. A detailed and controlled investigation of simultaneous focus marking in TİD will show how simultaneity is organized to convey prominence not only in sign language typology but also across modalities. The next section is an overview of focus realization in spoken and sign languages, which paves the way for the current study's design. Section 3 presents the methodology of this study. Section 4 illustrates the results, followed by a discussion of the findings in Section 5.

2. Information structure: focus realization

Vallduví and Engdahl (1996, p. 466) suggest information structure to be a 'terminological minefield' in the sense that the same term can denote different concepts in different studies, or the same concept can conflate additional terms. Hence, we will briefly discuss how focus and its subtypes are used in this study. Focus indicates the presence of alternatives (Rooth, 1992). In this study, we investigate the prosody of narrow focus in that there is a single constituent that bears focus in each sentence. In (3), the focused object evokes a set of alternatives, and the alternatives in the set differ only concerning the focused phrase. All the other constituents are non-focused.

(3) A: What is Ece eating?
B: Ece is eating [a banana]FOC
alternative set: {Ece is eating a banana, Ece is eating an apple, Ece is eating a pear…}

Broad focus sentences, as in (4), in which the whole sentence is focused, are not within the scope of this article.

(4) A: What is happening?
B: [Ece is eating a banana]FOC
alternative set: {Ece is eating a banana, Aslı is opening a box, Ayşe is throwing a pencil…}

A binary classification is made for focus as presentational focus (PF) and contrastive focus (CF). PF signals the presence of alternatives triggered by wh- questions as in (5). CF evokes a set of alternatives triggered by alternative questions or corrective statements as in (6).

(5) A: Who is eating the banana?
B: $[\text{Ece}]_{\text{PF}}$ is eating the banana.
alternative set: {Ece is eating the banana, Ayşe is eating the banana, Mert is eating the banana…}

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(6) A: Is Ece or Mert eating the banana?
B: $[\text{Ece}]_{CF}$ is eating the banana.
alternative set: {Ece is eating the banana, Mert is eating the banana}

Cross-linguistically, there is no unique strategy to mark focused constituents. A language can use morphological, syntactic or prosodic domains or an interface of these domains to realize focus. Büring (2009, p. 178) suggests that spoken languages can use pitch accent placement, prosodic grouping or boundary placement (word or phrase boundaries) in prosody, constituent order in syntax, particular morphemes in morphology or no marking at all to signal the prominence of focused constituents. In Hungarian, the immediate preverbal position is the target position for narrow focus as in (7a). The particle 'meg' is in the postverbal position, which indicates that the verb is inverted, and the verbal modifier 'on the leg' bears a narrow focus. In (7b), in the broad focus condition, the particle does not exist, and the immediate preverbal position is filled with the verbal modifier. Genzel et al. (2014) found that, even in this syntactically designated position, the narrowly focused verbal modifier differs from the modifier in the same position when the whole sentence bears focus. The narrowly focused verbal modifier in (7a) has a higher pitch height and longer duration than the verbal modifier in the broad focus condition in (7b).

(7) a. *Ilona* $[\textit{lábon}]_{\text{FOC}}$ *lövi meg Ádelt a film végén*
Ilona on-the-leg shoots PRT Ádel-ACC the film end-at
'Ilona shoots Ádel on the leg at the end of the film.'
b. $[\textit{Ilona lábon lövi Ádelt a film végén}]_{FOC}$
Ilona on-the-leg shoots Ádel-ACC the film end-at
'Ilona shoots Ádel on the leg at the end of the film.'
(Genzel et al., 2014, p. 9, with our minor modifications)

This finding is noteworthy in the sense that, alongside the syntactic strategy, Hungarian uses two available tools, length and pitch, from the same channel to mark a narrowly focused constituent. The investigation of focus marking becomes more intriguing in spoken languages as speech prosody, which relies on acoustic features, can use accompanying visual gestures. Gestures are temporally aligned with the prosodic structure reflecting prosodic grouping or the prominent units (Dohen et al., 2006; Esteve-Gibert et al., 2017; House et al., 2001; Loehr, 2012; Prieto et al., 2015; Wagner et al., 2014). In a production study, Carignan et al. (2021) investigated whether the F0 peak, which is a phonetic correlate of focus in French, aligns with a head nod gesture based on sentences with the template given in (8). In the target sentences, either the noun or the adjective is narrowly focused.

(8) No, take the [noun] [adjective]

The results indicate that French uses multimodal prosody to mark focus. The F0 peak that marks the focused noun or adjective either aligns with the apex of the accompanying head nod stroke or the point of the maximum velocity of head nod. To sum up, spoken languages simultaneously use different strategies from the two modalities to express focus. The following section investigates how focus is realized in sign languages.

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2.1. Focus in sign languages

Sign languages align with spoken languages using multiple strategies, such as modulated manual signs and nonmanuals, to convey information structure. The strategies to mark focus noted in the literature are the nonmanuals (head, brow, body or eyelid movements) in multiple sign languages (ASL: Wilbur, 2000a; DGS: Herrmann, 2015; Waleschkowski, 2009; NGT: Kimmelman, 2014; Van der Kooij et al., 2004; RSL: Kimmelman, 2014 and FinSL: Puupponen et al., 2015) the syntactic tools (doubling in ASL: Petronio, 1993; cleft in ASL: Wilbur, 1994, 1996), placement in clause-final position in ASL (Wilbur, 1999), or fronting in ASL (Lilo-Martin & Quadros, 2008), also in RSL and NGT (Kimmelman, 2014) and the modulations of manual signs in RSL and NGT (Kimmelman, 2014) and in ASL and LSF (Schlenker et al., 2016). As illustrated in (9), ASL indicates focus via a cleft sentence. Note that the nonmanual marker, brow raise, accompanies the cleft sentence.

(9) br
ME DISLIKE WHAT, LEE POSS TIE
'What I dislike is Lee's tie.' (Wilbur, 1996, p. 246)

Nonmanuals co-occur with other strategies not only in ASL; this is also observed in other sign languages. Kimmelman (2014) examines syntactic strategies, manual modulations and nonmanuals in Russian Sign Language (RSL) and Sign Language of Netherlands (NGT). He argues that nonmanuals, manual modulations and syntactic strategies can be the different realizations of focus prominence. Kimmelman (2014, pp. 123–124) expects these strategies to appear in complementary distribution rather than in combination.

First, manual and nonmanual strategies have different patterns in NGT and RSL. To illustrate, we summarized Kimmelman's (2014) findings on nonmanuals in RSL and NGT. Table 1 displays each nonmanual marker attested in both languages, along with the percentage of their occurrence. It indicates whether they correlate with focus presence if they are specific to a focus type, and if they are specific to a syntactic role. As seen in the table, nonmanuals often do not correlate with the presence of focus. Kimmelman (2014) also proposes that nonmanuals in RSL are not the marker of focus. Only NGT can be proposed to have nonmanuals as the markers of focus. However, even when the occurrences of nonmanuals correlate with focus in NGT, the percentages of their occurrences are not above 30%.

As for the modulations in manual prosody, such as length, repetition, size, speed and height in RSL and NGT, we summarized Kimmelman's (2014) findings on the realizations of manual signs which were affected in focus and non-focus positions based on focus type (information, selective and corrective), movement types (normal path, small path, hand internal)[3] and syntactic roles in the two sign languages RSL and NGT. Even though manual strategies were observed in both focus and non-focus signs, as seen in percentages in Table 2, their occurrences are more consistent than those of nonmanuals. As one of the few studies investigating the effect of focus on manual signs,

[3]While we followed Brentari's (1998) classification in our study, we referred to original terms that used by the cited authors. Kimmelman (2014, pp. 86–87) defines movement types as follows: hand-internal movement – one or more of the joints in the palm, small path movement – more proximal joints can be used, but the path is small in size, and normal path – larger in size.

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Table 1. Observed nonmanuals in Kimmelman (2014)

Language	Nonmanual	Occurrence (%)	Focus presence	Focus type	Syntactic role
RSL	br	5	Not correlated	All	All
NGT	br	20	Correlated	All	All
RSL	bht	4	Not correlated	–	S & O
NGT	bht	21	Correlated	All	O
RSL	bbl and fbl	9	Not correlated	–	V
NGT	bbl and fbl	12	Not correlated	–	V
RSL	sbl	–	Correlated	Contrastive	All
NGT	sbl	–	Correlated	Contrastive	All
RSL	hn	19	Correlated	Selective	S & O
NGT	hn	30	Correlated	All	S & V
RSL	m	32	Not correlated	Corrective and selective	All
NGT	m	24	Not correlated	Corrective and selective	All
RSL	eg	29	Not correlated	–	–
NGT	eg	21	Not correlated	–	–

Abbreviations: bbl- backward body lean, bht- backward head tilt, br- brow raise, eg- eye gaze, fbl- forward body lean, hn- head nod, m- mouthing and mouth gestures, O- object, S- subject, sbl- sideward body lean, V- verb.

Table 2. Summary of strategies used in manual modulations in Kimmelman (2014)

Lang.	Str.	Rlz.	f > nf [1] (%)	f < nf[2] (%)	Ratio [1]/[2]	Focus type	Movement type	Syn. Role
RSL	Length	Longer	64	11	6	All	All	All
NGT	Length	Longer	63	7	8.5	Information	All	All
RSL	Rep.	More rep.	44	5	9.28	All	Small path and hand internal	All
NGT	Rep.	More rep.	36	4	9.71	All	All	All
RSL	Speed	Slower	20	10	2	All	All	All
NGT	Speed	Slower	22	5	4.2	All	Normal path	All
RSL	Size	Larger	14	6	2.33	Information	Normal path	All
NGT	Size	Larger	27	4	6.25	All	Small path	All
RSL	Height	Higher	10	2	5	Information	Hand internal	All
NGT	Height	Higher	17	4	4.43	All	All	All

Note: Percentages are taken from Kimmelman (2014, p. 91).
Abbreviations: f- focus, Lang.,- language, nf,- non-focus, Rlz.,- realization, Str.,- strategy, Syn. Role- syntactic role.

he showed that different strategies were used to mark focus and focus sub-types, such as longer signs, more repetition or slower signs when they were focused.[4]

As seen in Table 2, NGT and RSL do not use the same manual prosodic strategies for the same purpose, and there are some language-specific tendencies. For example, repetition was used more with the signs that have a small path or hand internal movement in RSL. In NGT, on the other hand, signs with hand-internal and a small path movement are marked less frequently by length than signs with normal path movement. These patterns can be due to the specific phonological restrictions in each language.

[4]Kimmelman (2014, p. 90) notes that length is, in fact, a cumulative measure shaped by the movement's size, speed and number of repetitions. Still, he takes length as a separate manual strategy to include instances of hold, as a result of which a sign ends up with a longer duration, and the parameters are not changed.

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The other important finding of this study is that in NGT and RSL, syntactic roles are not distinguished with respect to the manual markers of focus in that subject, object or verb can be marked via manual prosody. Manual channel in both languages is used in all syntactic roles. As for nonmanuals, Kimmelman (2014) reveals that in NGT, all syntactic roles can be marked by eyebrow raise (br) while there is a tendency for backward head tilt (bht) to accompany object focus and head nod (hn) to accompany subject focus. Nonmanual channel, in contrast to manual channel, distinguishes focus positions with different nonmanuals. Hence, the interaction of manual and nonmanuals of focus and syntactic roles needs further investigation from a cross-linguistic perspective.

The most important finding of this study is typological distinction in the organization of simultaneity for information structure. That is, NGT uses manual and nonmanual channels to express focus prominence. RSL uses the manual channel, but nonmanuals rarely accompany focus, and hence, RSL is suggested to use a single channel to encode focus prominence. Although many studies in sign language literature reported nonmanuals in information structure, Kimmelman (2014) is one of the few studies that reports the percentages of occurrences for manual and nonmanuals. Thus, without knowing the consistency of strategies, one cannot conclude if sign languages use multi-channels for encoding focus or if there is a division of labor between these channels.

In terms of the typological distinction between NGT and RSL, TİD can be another language patterning with RSL based on the literature. Syntactic strategies include doubling, cleft and fronting (Makaroğlu, 2012), and nonmanuals such as eyebrow raise, eye blinks and eye squint (Gökgöz & Keleş, 2020) have been suggested for TİD. We still do not know the frequency of these syntactic strategies and whether they are accompanied by nonmanuals. A recent study found that eyebrow raise mainly accompanies corrective statements; eye squint and eye blink do not necessarily accompany focused constituents based on an analysis of free conversations and elicited data (Gürer & Karabüklü, 2022). Head nod is suggested as a potential nonmanual marker to mark focus in TİD, but the researchers suggest that head nod cannot be a pure focus marker. As the following examples illustrate, while head nod appears over the focused constituent (ASLI) in (10), head nod also appears over the topic constituent (VELI) in (11). Authors suggest that head nod is the edge marker of a phonological phrase. Thus, these findings suggest that nonmanual channel in TİD is not the primary source of prominence.

(10) Q: hs
IX-3 RABBIT IX-3 WHO
'Who has the rabbit?'
A: hn
ASLI$_{FOC}$ RABBIT EXISTENTIAL PALM-UP
'Aslı has the rabbit.' (Gürer & Karabüklü, 2022)

(11) Q: hs
VELİ IX-3 WHAT IX-3
'What does Veli have?'
A: hn, br
VELİ, [CLEMENTINE TWO]$_{FOC}$ EXISTENTIAL
'Veli has two clementines.' (Gürer & Karabüklü, 2022)

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Gürer and Karabüklü (2022) also note that focused signs have longer durations compared to non-focused signs. However, their data set does not include enough minimal pairs of focused and non-focused signs, preventing a conclusive analysis. The interaction of focus and the nonmanuals is also not discussed in their study. Hence, how focus is marked and how this strategy interacts with nonmanuals is still a mystery. Thus, building on the findings in the literature, this study investigates how manual and nonmanual channels are organized to mark focus in TİD.

3. Methodology

Building on the typological patterns in NGT and RSL and the literature in TİD, we aim to reveal how manual and nonmanual prosody is used to mark focus and their possible interactions in TİD. The results are expected to shed light on multi-channel strategies in the visual-gestural modality.

Within the manual prosody domain, Kimmelman (2014, p. 90) comes up with a list of parameters such as length, repetition, size, speed and height as markers of focus prominence, and based on NGT and RSL data he suggests that a focused sign is lengthened, repeated, bigger in size, slower and higher in the signing space than a non-focused manual sign. Building on Kimmelman's (2014) findings; we propose that, except for height, all these different parameters can be the realizations of a broader strategy: longer duration as a hyper-articulation strategy in the visual-gestural modality for the focused constituents. If a signer holds or repeats a manual sign, increases the size or lowers the speed of a manual sign, in turn, the duration of the sign will be increased. Hence, regardless of the strategy, if we measure the duration of a manual sign, we can reveal how it interacts with focus prominence. Hence, we raise the following first two questions:

Q1: Do focused signs have a longer duration than their non-focused counterparts?
Q2: Do focus types (contrastive or presentational focus) affect the duration of focused signs?

Within the nonmanual channel, studies in the literature mentioned nonmanuals as focus markers, and hence we raise the following question:

Q3: Does focus yield more nonmanual production?

Sign language literature has abundantly shown the effects of age of acquisition (early exposure vs. delayed exposure) of the first language on linguistics (Lilo-Martin et al., 2020; Mayberry et al., 2002; Mayberry & Eichen, 1991), academic (Hrastinski & Wilbur, 2016; Wilbur, 2000b) and social life (Pfau et al., 2021). Most Deaf children are not exposed to sign language from birth since they are born to hearing parents and do not get early intervention for sign language. Deaf children in that situation are usually exposed to sign language later in life (Mayberry, 2007; Mayberry & Kluender, 2018). Since Deaf populations consist of signers with different backgrounds, we balanced our participant pool with participants exposed to TİD from birth and those exposed to TİD later in their lives. Hence, our next research question is on the possible effect of age of acquisition.

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Q4: Does the age of acquisition, whether the signers are Deaf children of Deaf adults (DoD) or Deaf children of hearing adults (DoH), influence the strategies used in focus marking?

Additionally, signing duration was reported to be affected by the signing rate, which causes changes in the number of pauses, nonmanuals and pause duration (Wilbur, 2009). If an elicitation phase is repeated, the signers are expected to sign at a faster rate in the second phase. Hence, the last research question is on the possible effect of signing rate on focus marking.

Q5: Does the signing rate influence the strategies used in focus marking in the first and second elicitation phases?

In the current study, to test these hypotheses, we controlled focus type (contrastive or presentational), the syntactic role of the focused item (subject, verb, or object) and verb type in terms of the movement pattern of the sign (local, path, or local and path together). We recruited participants from both DoD and DoH groups. We tested the effects of these independent variables on the dependent variables, namely the duration of focused and non-focused signs and the appearance of nonmanuals.

3.1. Participants

Twenty Deaf participants (17 female, age M = .34, SD = 34, range = 23–50) took part in the study. Ten participants were Deaf of Deaf (DoD) and 10 Deaf of Hearing (DoH). All the participants were living in Istanbul. DoH participants self-reported that they were first exposed to TİD at school. Children in Turkey need to start primary school at the age of 7, and Deaf children who went to Deaf schools were usually first exposed to signing via their peers (Göksel et al., 2021; İlkbaşaran, 2015). Since we lack information about their exact age of exposure to TİD before this period, we treat all DoH participants as one group. However, we acknowledge that DoH participants form a more heterogeneous group than DoD participants in terms of their age of exposure to the language and the language model that they were exposed to. That is, DoD participants were first exposed to language models from adult signers, while DoH participants were first exposed to language models from their peers whose acquisition was continuing. As for their participation in the current study, the participants signed a consent form and received a small amount of compensation.

3.2. Design and materials

As discussed in the literature, the prosodic realization of focus can be shaped by (i) the focus type, that is, presentational focus or contrastive focus, (ii) the syntactic role of the focused sign (S, O, or V) and (iii) the type of movement of the sign (internal, path, and internal and path together). Hence, we designed the current study based on a 2 (focus types) × 3 (syntactic roles) × 3 (verb types) × 2 (repetitions) factorial design.

We used wh- questions to elicit presentational focus as in (12)–(13) and alternative questions for contrastive focus as in (14). The examples illustrate the target sentences with a focus on the subject (12), object (13) and verb (14) as used in the study.

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(12) A: WHO BANANA EAT?
'Who is eating the banana?'
B: [ECE]$_{PF}$ [BANANA] [EAT]
'Ece is eating the banana.'

(13) A: AYŞE WHAT THROW?
'What is Ayşe throwing?'
B: [AYŞE] [PENCIL]$_{PF}$ [THROW]
'Ayşe is throwing the pencil.'

(14) A: ASLI BOX DO WHAT? OPEN OR CARRY?
'What is Aslı doing with the box? Is she carrying or opening the box?'
B: [ASLI] [BOX] [OPEN]$_{CF}$
'Aslı is opening the box.'

All conditions with focus types and syntactic roles are illustrated in Table 3. Note that the design enables us to compare focus types, and focused and non-focused signs in similar conditions. The presentational focus subject in Table 3 (Condition a) can be compared to the contrastive focus subject in Table 3 (Condition d) but also to the non-focused variety in Table 3 (Condition b).

As found in Kimmelman's (2014) study, the type of movement of the sign may yield different strategies to convey focus. To check whether the type of movement affects the prosodic realization of focus, we chose verb signs that had different movement types based on Brentari (1998, pp. 129–130). We included signs for verbs from three categories: (i) local movements, which are articulated by the wrist or finger joints, (ii) path movements which are articulated by the elbow or shoulder joints and (iii) the combination of local and path movement. Brentari (1998) classifies local and path movements as simple movements while the co-occurrence of two or more local or path movements as complex movements. As seen in the first two frames of Figure 2, the sign for EAT includes a local movement where the movement originates at the wrist. The handshape and orientation of the movement are preserved. OPEN is signed with a path movement where the movement originates at the elbow. The handshape is preserved while the orientation of the dominant hand changes (third and fourth frames in Figure 2). Lastly, throw is signed with local and path movement where the movement simultaneously originates at both wrist and elbow (last two frames in Figure 2). The handshape and the orientation of the dominant hand also change in throw.

Six conditions in Table 3 were repeated for each target verb EAT, OPEN, and THROW. We did not counterbalance the movement type for the manual signs used as the subject and the object in order to avoid fatigue in participants due to too many

Table 3. Focus types and syntactic roles

Conditions	Syntactic roles × Focus type		
a	[S]$_{PF}$	O	V
b	S	[O]$_{PF}$	V
c	S	O	[V]$_{PF}$
d	[S]$_{CF}$	O	V
e	S	[O]$_{CF}$	V
f	S	O	[V]$_{CF}$

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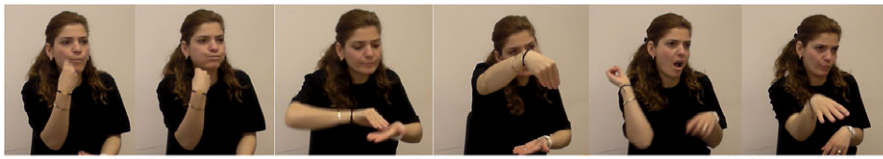

Figure 2. Verbs used in the stimuli.

target items. In addition to these 18 target items, we included 54 filler items in the study. The fillers were composed of three groups: yes/no questions, the questions of where, and how many. The items were randomized for each participant and session.

3.3. Procedure

For the current study, there were two alternative procedures: (i) participants could ask the questions and then answer them with elided answers, and (ii) participants could answer the questions in full sentences directed by the Deaf research assistant. In the first alternative, to compare the focused and non-focused signs, the focused manual signs are extracted from the answers and the non-focused manual signs from the questions. This is a natural elicitation process for the answers as the non-focused constituents are likely to be elided in natural conversations too. However, the question-answer flow should happen between two interlocutors. Additionally, as the non-focused items are extracted from the questions, the question intonation can be a confounding variable for the comparisons of focused and non-focused manual signs. In the second alternative, although the participants are asked to give a complete answer, the question-answer flow is more natural. As the focused and non-focused items are all extracted from the answers, question intonation as a possible confounding variable is obviated. Hence, we decided on the second procedure.

The Deaf of Deaf research assistant carried out all sessions with the participants, and all the instructions and explanations were in TİD. The participant and the assistant sat at a table facing each other with a computer in front of them. First, the assistant introduced five characters, three characters from the target sentences and two from the filler sentences, with their given name signs in the stimuli. These name signs and the signs for objects include local movement or path movement.

Next, a short trial session was conducted with each participant to familiarize them with the task. To make the sessions more naturalistic, the assistant only saw the questions and the participant only the GIF images. Figure 3 presents the still pictures of the GIF for 'opening a box'. Participants saw GIF images for both the target and the filler items where the introduced people were actualizing an event, as in 'Aslı is opening a box'.

The participants were asked to reply to the assistant's questions based on the GIF images in a single complete sentence. During the trial session, if they gave a short answer to the questions, they were reminded to answer in complete sentences.

Each participant repeated the session once again in a new randomized order and took a 15-minute-long break in between. There were 36 utterances for each participant: 2 (focus types) × 3 (syntactic roles) × 3 (verb types) × 2 (repetitions) = 36.

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Figure 3. Still pictures of the GIF for 'opening a box'.

During the break, the participants were asked to fill out the background questionnaire. All sessions were recorded with three cameras: one for the participant, one for the assistant, and one for both. The first session lasted approximately 20 minutes and the second one 15 minutes.

3.4. Statistical analysis

3.4.1. Annotation and coding of manual signs

Another Deaf research assistant glossed the target sentences in TİD using ELAN software (Crasborn & Sloetjes, 2008). The authors further annotated these sentences for the type of focus (PF or CF), the syntactic role of the focused items (S, O, or V) and verb type (internal movement, path movement, or both).

The duration of focused and non-focused signs in the target sentences was obtained based on the Deaf researcher's annotations in milliseconds in ELAN. The coding system of Kita et al. (1998) was used, according to which there are three main phases: preparation, expressive, and retraction phases. In the preparation phase, the articulators depart from the resting position to the location of the manual sign; the shape and the orientation of the hands are prepared for the onset of the manual sign as illustrated in the second frame in Figure 4 for the sign ECE where the handshape of the sign is formed. Hands are moving to the signing location. In the expressive phase, the handshape and the location of the manual sign are fully formed, and the movement of the sign is realized. The sign can be clearly observed with its all phonetic features, handshape, location and movement (third and fourth frames in Figure 4). Since holds and repetitions could be potential strategies for focus marking (Kimmelman, 2014), dependent holds or repetitions of the sign are included within this phase as long as the handshape and the location of the manual sign are preserved. In the retraction phase, the articulators move back to the resting position (tabletop or keyboard) or move to the next sign. Each author separately identified the expressive phases of the signs in the target conditions for half of the data sets, and then each checked the coding of the other half. Lastly, they together discussed the cases where there was disagreement in the coding. The measurements of duration were based on these expressive phases.

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Figure 4. (1) The handshape and location of the manual sign 'ECE'; (2) the preparation phase; (3) the expressive phase; (4) the expressive phase and (5) the retraction phase.

As seen in Table 3, the focus value came from a single instance per participant and session. To illustrate, the focus value for the PF subject would be as in Condition A. In contrast, the non-focus value for the PF subject would be based on the duration of the subject in either Condition B or Condition C. A possible way to code data for the analysis is to enter each value separately for non-focus. Another possibility is to code the mean duration of subjects in Conditions B and C. We opted for the first option in the analysis and reported the results based on that option, yet we also provided the results of the full model on the mean data in the Supplementary Material.

If a participant used a different verb than the target one or answered the question without a complete sentence, these were coded as missing data points. With 36 utterances for each participant, there were 720 data points for focused items and 1440 for non-focused ones. There were four missing focused items out of 2160 data points in total.

3.4.2. Annotation and coding of nonmanuals

Based on the previous findings (Gökgöz & Keleş, 2020; Gürer & Karabüklü, 2022; Makaroğlu, 2012), authors annotated the nonmanuals for the movements of head, eyebrows and eyelids. Annotations were carried out by using the articulatory model for nonmanuals template (Kentner et al., 2022). The template allowed the authors to annotate the nonmanuals more consistently based on the axis that movement occurs whether (i) the movement is single, repeated, or trilled, (ii) the movement is symmetric or not for bi-articulators as seen in Figure 5. The template includes tiers for each articulator.

As seen in Figure 5, head nod occurs over the sign AYŞE. The template includes a parent tier for the articulator head, where the occurrence of the nonmanual is annotated. It was annotated as single if there is one head movement. If it was repeated like head shake in negation or trilled movement like head shake in wh- questions, it was respectively annotated as multiple or trilled. The child tiers denote the axes that the articulator can move. In these tiers, the direction of movement was annotated, that is, both for head nod, including the preparatory phase, apex, and the return. Lastly, the degree of movement was annotated as min, mid, or max based on its magnitude. The template includes the same annotation schema, ensuring consistency across annotations of different articulators and across annotators.

Following the annotations, we coded the production of nonmanuals as binary. If a nonmanual appeared over a syntactic item (subject, object or verb), it was coded as 1, otherwise as 0. If that item was focused, focus was coded as 1, otherwise as 0. Syntactic

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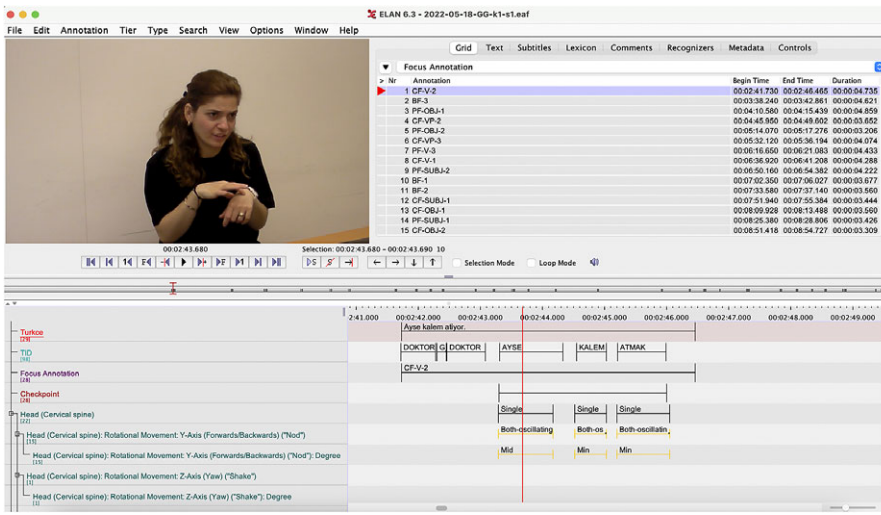

Figure 5. Template used to annotate the data.

roles were coded categorical as subject, object and verb. Each nonmanual head nod, eyebrow raise and squint was also binary-coded. If a lexical sign was omitted, the corresponding nonmanual was coded as missing. There were 13 missing items out of 2160 data points coming from the three syntactic roles in 720 utterances. The rest of the variables, such as session, age and age of acquisition, were coded the same as in the coding system of the duration data.

3.4.3. Data analyses

The design of the experiment included the between-subjects variable AoA (with the two groups: DoD – exposure to TİD from birth and DoH – exposure to TİD from 5–7 years of age). The within-subjects variables were (i) focushood (focused and nonfocused), (ii) focus type (PF and CF), (iii) session (first and second), (iv) syntactic role (subject, object and verb) and (v) verb type (ACMAK (open), ATMAK (throw) and YEMEK (eat)).

All data points were analyzed in R by using linear mixed models (package *lme4*, Bates et al., 2014). Model comparisons starting with the baseline model were used to derive the significance of the mixed model. The baseline model included random effects and significant confounding factors. Significance levels were derived by comparing models and by using *emmeans* package with Tukey's HSD (Lenth, 2019) in R.

Mixed effects models were used to test the effect of focus, focus type, age of acquisition (AoA), syntactic role, verb type, and session on the duration of manual signs and the production of nonmanuals. Mixed effects models also make it possible to examine the random effects on the response variables due to the individual trials and the participants. Thus, in the analysis, items and participants were modeled as random factors. Including random intercepts for the items can explain possible variability in that some items might yield longer or shorter duration and more or fewer nonmanuals than others. Additionally, participants may be differently prone to

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duration and nonmanuals in that some may sign at a slower or faster rate than others. Thus, random intercept for the participants was also included. Lastly, some combinations of independent variables might yield longer or shorter duration rates or more or fewer nonmanuals for some participants but not for others. Hence, the random slopes were also considered and tested for the dependent variables by participants, yet the model did not converge with random slopes. Moreover, a series of models were run to account for possible confounding fixed factors such as gender and age. The final baseline model was determined based on the best fit based on ANOVA tests or the model with the maximal random effects that converged (Barr et al., 2013). All analysis scripts are presented in the Supplementary Material.

4. Duration

4.1. Results

A linear mixed effects model was fit to assess the fixed effects of focus, focus type, syntactic role, verb type, and session on the duration of manual signs. The effects were compared to the baseline model, where participant and item were random factors. A series of models were also run to test the possible effects of confounding variables of age and age of acquisition. Age did not have a significant effect on the duration of signs. We did not test the effect of gender because the participant pool was unbalanced with 17 female participants; thus, it would have yielded a misleading effect. In the remainder of the study, we do not mention these factors unless they prove to be significant.

Results showed a highly significant main effect of focus on the duration of manual signs ($X^2(1) = 54.441$, $p < .001$). In other words, focused signs ($M = 0.540$, $SD = 0.05$) had significantly longer duration ($\beta = 0.075$, $SE = 0.01$, $t = 8.44$, $p < .001$) than non-focused signs ($M = 0.465$, $SD = 0.05$) (Figure 6).

Results also showed a significant effect of focus type ($X^2(1) = 4.178$, $p = .042$) and the significant interaction between focus type and syntactic role ($X^2(2) = 21.724$, $p < .001$). While focus and non-focus distinction was significant for CF in subject ($\beta = 0.142$, $SE = 0.02$, $t = 8.01$, $p < .001$), object ($\beta = 0.072$, $SE = 0.02$, $t = 4.06$, $p < .001$) and verb ($\beta = 0.064$, $SE = 0.02$, $t = 3.59$, $p = .002$), the difference was significant in PF only in subject ($\beta = 0.106$, $SE = 0.02$, $t = 6.01$, $p < .001$).[5] The focus type distinction between PF and CF was significant only in the subject. As seen in Figure 7, CF yielded longer signing duration ($\beta = 0.096$, $SE = 0.02$, $t = 5.15$, $p < .001$) than PF in the subject.

We also tested the possible interaction between the syntactic role and focus. Focus and position had a significant interaction ($X^2(2) = 15.363$, $p < .001$). As seen in Figure 8, the difference in duration between the non-focused and focused subjects was most prominent ($\beta = 0.124$, $SE = .02$, $t = 8.10$, $p < .001$). Then, it was followed by the difference in the object ($\beta = 0.054$, $SE = .02$, $t = 3.54$, $p < .001$). Lastly, the difference in verb was the least prominent ($\beta = 0.046$, $SE = .02$, $t = 2.99$, $p = .003$). There was also a significant effect of position on the overall duration ($X^2(2) = 475.23$, $p < .001$). Object had a significantly shorter duration than subject ($\beta = -0.152$, $SE = .01$,

[5]As noted in the data coding section, these results are based on the data where non-focus values were entered separately. We also ran the full model on the data where the mean of non-focus values was entered. PF distinction was the only change in the two results; that is, focus and non-focus distinction was significant in all syntactic roles. See Supplementary Material for details.

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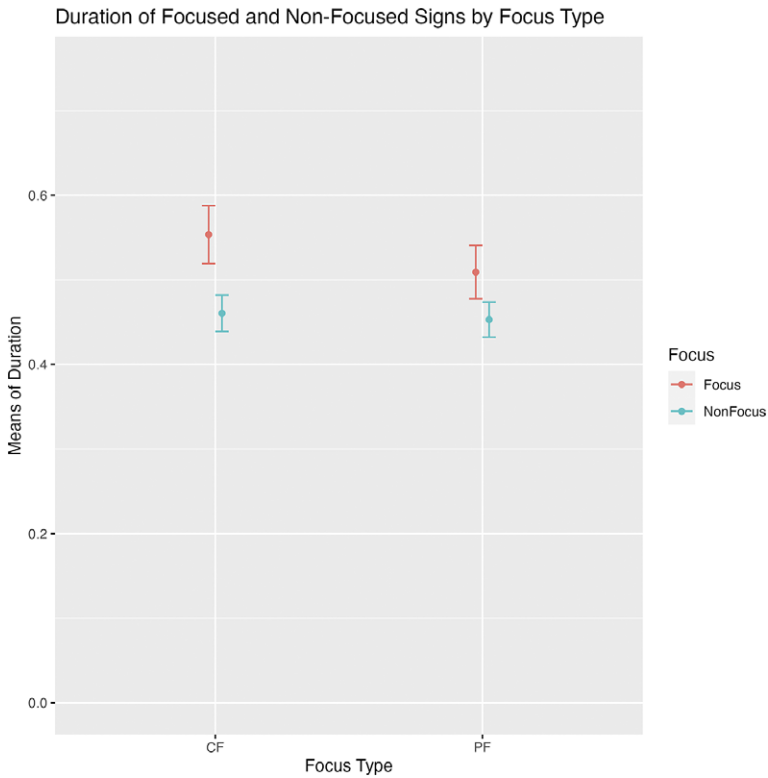

Figure 6. Duration of focused and non-focused signs by focus type.

$t = -13.99$, $p < .001$) and verb ($\beta = -0.241$, $SE = .01$, $t = -22.09$, $p < .001$). Subject had significantly less duration than verb ($\beta = -0.088$, $SE = .01$, $t = -8.12$, $p < .001$). Thus, our study also replicated the well-known phrase-final lengthening phenomena (Wilbur, 1999).

When the effect of age of acquisition (AoA) on the duration was tested, it had a significant effect ($X^2(1) = 4.062$, $p = .04$) Deaf of Deaf (DoD) participants had marginally significantly shorter duration ($\beta = -0.172$, $SE = .08$, $t = -2.03$, $p = .05$) than Deaf of Hearing (DoH) participants. Yet, AoA did not have a significant interaction with focus. Overall, DoH participants had longer signing duration than DoD signers, as seen in Figure 9.

Similarly, the session also had a significant effect on signing duration ($X^2(1) = 44.626$, $p < .001$). Participants had longer durations in the first session than in the second session ($\beta = 0.042$, $SE = .01$, $t = 4.96$, $p < .001$) as already noted in the literature (Wilbur, 2009). There was not a significant interaction between focus and session; thus, focus and non-focus distinction was observed in both sessions even though their signing rate was increased, as in Figure 10.

Lastly, we tested the effect of verb types and focus on the duration of verb signs. The linear mixed effect analysis was only run on the duration of the verb category since we did not control the internal phonetic features of signs in other syntactic roles. Verb types had a significant effect on duration ($X^2(2) = 36.114$, $p < .001$). There was a

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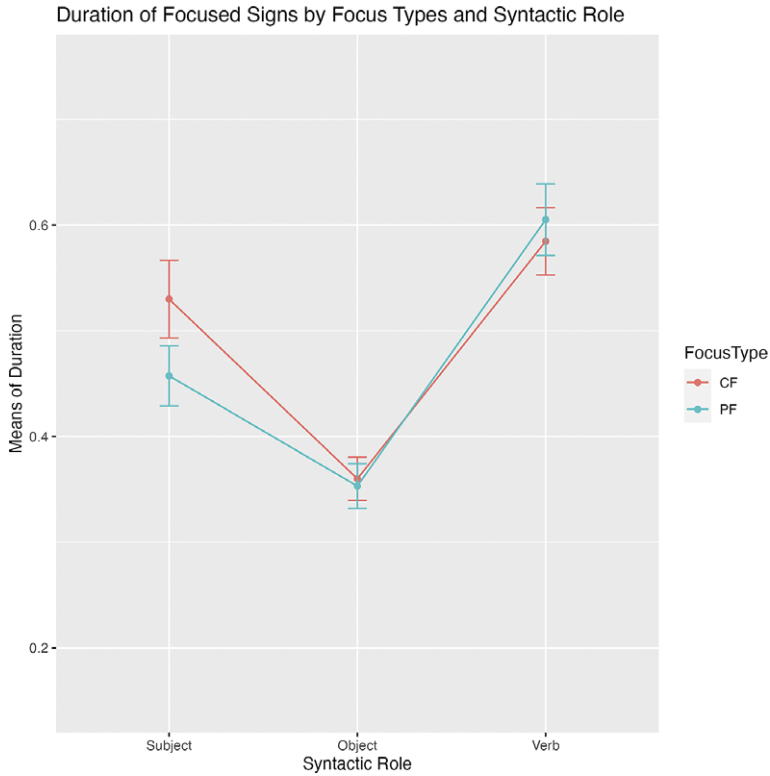

Figure 7. Duration of focused signs by focus type and syntactic role.

significant interaction between focus and verb types ($X^2(2) = 7.365$, $p = .02$). There was also a significant interaction between AoA and verb types ($X^2(3) = 9.811$, $p = .02$). Overall, the verb ACMAK (open) was signed significantly longer than verbs ATMAK (throw) ($\beta = 0.100$, $SE = .02$, $t = 5.68$, $p < .001$) and YEMEK (eat) ($\beta = 0.066$, $SE = .02$, $t = 3.72$, $p = .001$). There was no significant difference between ATMAK and YEMEK. The difference in verb duration was distinct between DoD and DoH participants. DoD participants signed ACMAK significantly longer than ATMAK ($\beta = 0.060$, $SE = .02$, $t = 2.59$, $p = .03$) and YEMEK ($\beta = 0.060$, $SE = .02$, $t = 2.60$, $p = .03$). They did not have significant difference between ATMAK and YEMEK. DoH participants not only signed ACMAK significantly longer than ATMAK ($\beta = 0.141$, $SE = .03$, $t = 5.54$, $p < .001$) and YEMEK ($\beta = 0.072$, $SE = .03$, $t = 2.81$, $p = .01$). They but also signed ATMAK significantly shorter than YEMEK ($\beta = -0.069$, $SE = .03$, $t = -2.74$, $p = .02$). As for the focus and non-focus distinction in verb types, it was significant only in YEMEK ($\beta = 0.102$, $SE = .02$, $t = 4.09$, $p < .001$) as in Figure 11.

4.2. *Discussion: manual prosody of focus*

The results showed that focus is marked via manual prosody in TİD, that is, increased duration. Signers modulate the manual signs to increase duration, and the focused variety of a sign is longer in duration than its non-focused counterpart. The results

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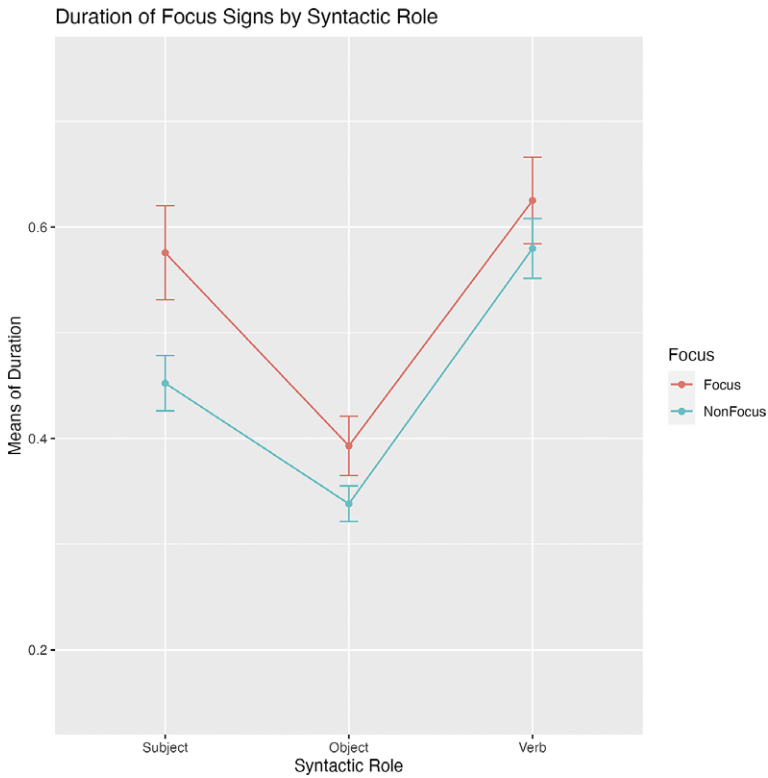

Figure 8. Duration of focused and non-focused signs by syntactic role.

show a pattern similar to the one in RSL as discussed in Kimmelman (2014). In terms of encoding prosody in sign languages, nonmanuals are argued to be the main channel, while manuals are suggested to show the constituent hierarchy (Brentari & Fenlon, 2020; Brentari et al., 2015; Dachkovsky & Sandler, 2009; Nespor & Sandler, 1999; Sandler, 1999, 2012). In contrast to the division of labor suggested in the literature, TİD encodes focus intonation via the manual channel similar to the pattern in RSL as discussed in Kimmelman (2014).

4.2.1. Focus types and duration

Although duration is the key parameter in encoding focus, presentational and contrastive focus do not behave in the same way. As a reminder, results showed that focus and non-focus distinction in presentational focus (PF) is only significant in the subject role, while the distinction in contrastive focus (CF) is significant in all syntactic roles. The distinction between PF and CF is also only significant in the subject role. This distinction between PF and CF is expected in that in spoken languages if a type of focus is marked or associated with an additional strategy, it is generally the contrastive focus. Remember that in Hungarian, a narrowly focused constituent has a higher pitch height and longer duration than the same unit in the broad focus condition, as illustrated in (7). Additionally, focus can affect the tonal

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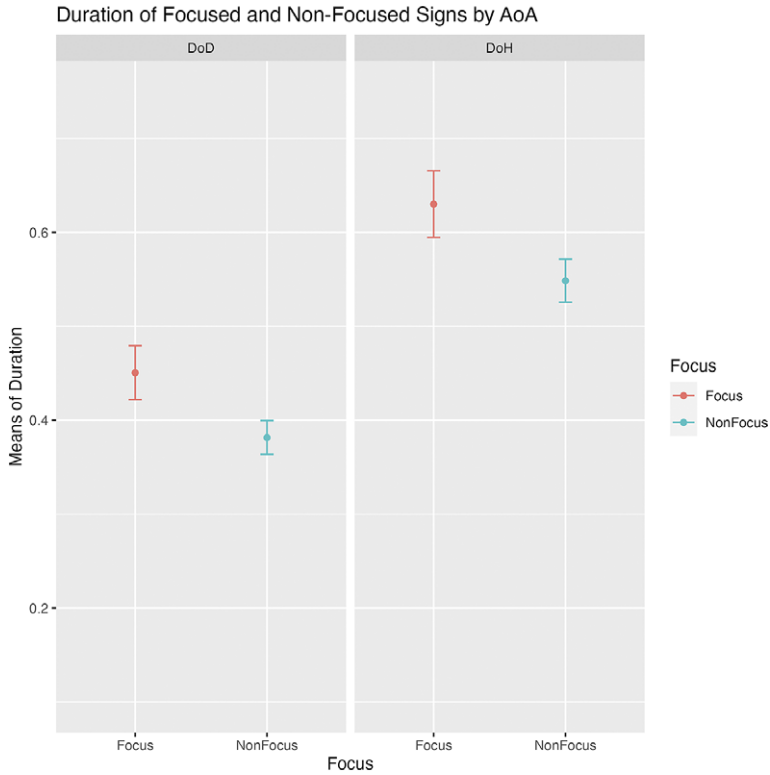

Figure 9. Duration of focused and non-focused signs by age of acquisition.

scaling of the neighboring constituents. Genzel et al. (2014) further suggest that the constituents preceding and following a focused constituent are even less prominent, with lower pitch values when the focused constituent is a contrastive focus. However, the same pattern is not observed with presentational focus. We suggest that this marked nature of contrastive focus is the motive behind the obligatory manual prosodic strategy with contrastive focus in TİD.

What is more interesting in TİD is the fact that presentational focus is realized via duration with a single grammatical function, that is, the subject. This pattern is not common in most well-known intonation languages, but the subject/non-subject split is observed in West Chadic languages (Hausa, Tangale and Bole) as well (Zimmermann, 2011). Zimmermann (2011) notes that contrastive focus is always marked grammatically via syntactic, morphological or prosodic strategies, while presentational focus tends to be unmarked. However, presentational focus is obligatorily marked if the constituent is the subject. Some other West Chadic languages, such as Ngizim, Duwai, and Bade take a further step, and they never mark focus (contrastive or presentational) on nonsubjects, even optionally. However, even in these languages, focus realization is obligatory for the subjects.

The following question is raised at this point: what is special about the syntactic role of the 'subject'? Zimmermann (2011) suggests that the unmarked partition is to have a topic-comment sequence in which the subject is the topic of the sentence.

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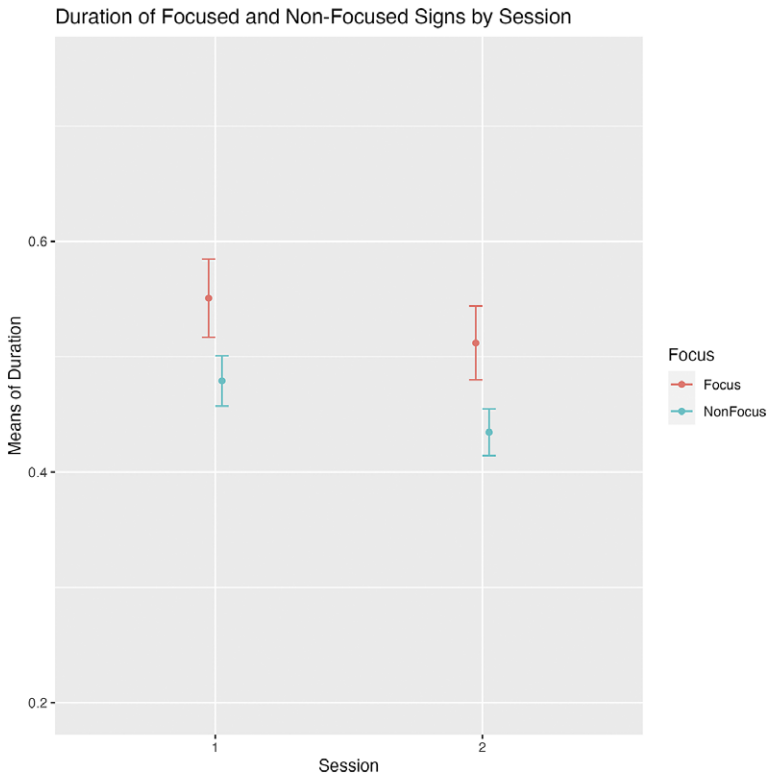

Figure 10. Duration of focused and non-focused signs by session.

When the packaging is not on par with the default setting, namely when the subject bears focus, it is marked obligatorily. In line with Zimmermann (2011), we suggest that the subject is marked obligatorily with presentational and contrastive focus because focushood is the marked or unexpected information packaging option for a subject in topic-comment configuration. That is why in TİD, regardless of focus type, a subject is marked in the manual channel via an increase in duration. An object or a verb that bears presentational focus is not marked because they are not unexpected or unmarked topicalized units in a sentence, and hence, they can bear focus. Yet, this hypothesis needs to be further tested in a study where topic-comment structure is controlled. On the other hand, contrastive focus is always marked with each syntactic role because contrastive focushood itself is the typologically marked option in the focus field, as indicated above.

4.2.2. Phonetic structure of the sign and duration

There was an interaction of the focus and the verb type, as seen in Figure 11. That is, the focused and non-focused distinction was prominent with the verb YEMEK (eat), but not in other verbs ACMAK (open) and ATMAK (throw). As shown in the literature, the phonetic structure of a sign can affect the strategies used to lengthen the duration of the sign. Kimmelman (2014, 113) suggests that 'focused signs can be longer, larger, slower and/or higher, and they may contain more repetitions than their non-focused

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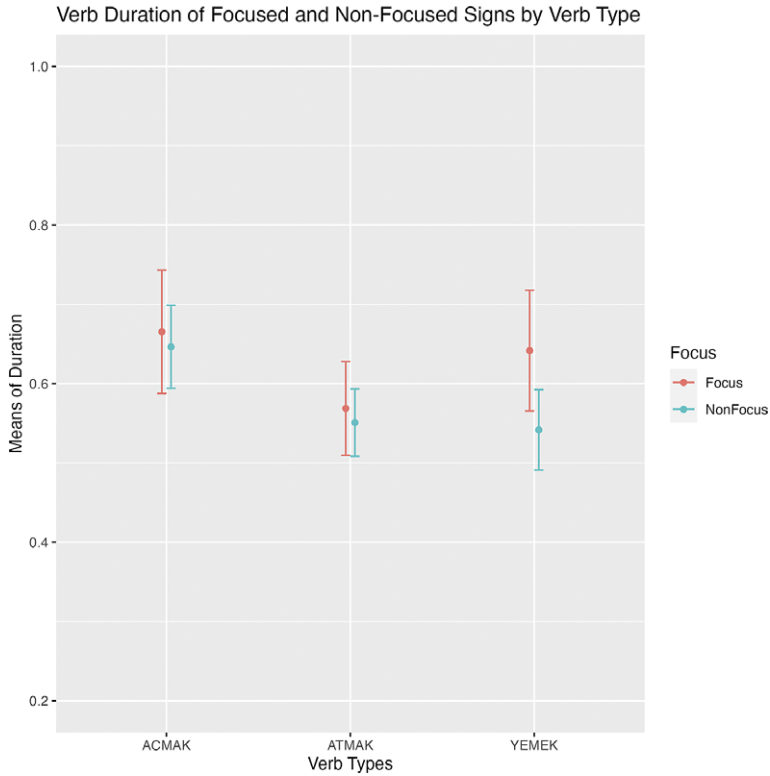

Figure 11. Duration of focused and non-focused signs by verb type.

version. (…) However, it is clear that type of movement is an important predictor of markers of focus and that there is cross-linguistic variation'.

Thus, the movement type of the verb in our data is the possible source of the interaction effect that we observed. The verb signs came from three phonetic groups: (i) local movement – YEMEK (eat), (ii) path movement ACMAK (open) and (iii) local and path movement – ATMAK (throw). We suggest that signers can modulate some salient parameters such as repetition, hold, lengthening, size, and speed based on the phonetic features of the sign to increase duration. Yet, a quantitative analysis of the parameters that signers use to increase duration is beyond the scope of this article.

As for the strategies to modulate the parameters, we have observed that repetition of the sign was a common strategy for the verb YEMEK (eat), while hold was observed more with ACMAK (open) and extending the arm at the beginning of the sign with ATMAK (throw). Figure 12 shows the focused versions of AÇMAK, ATMAK and YEMEK, respectively. First, the participant held the focused verb AÇMAK longer at the end of the expressive phase than the non-focused one.

As for the verb ATMAK, we observed that the participant started the sign further back when it was focused than the non-focused one, thus yielding a longer path and duration. Lastly, in YEMEK, the participant fully repeated the sign when it was focused by returning to the starting point at the third frame of the bottom row in Figure 12. The non-focused version was usually partially repeated without fully returning to the

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Figure 12. Focused versions of ACMAK, ATMAK and YEMEK, respectively.

beginning of the sign. In a nutshell, the full reduplication of a sign would yield a more prominent duration difference than modulating a part of its phonetic form. However, a systematic analysis of more items for each verb type, that is, local movement, path movement, local and path movement, is required to safely conclude that the phonetic structure of the sign affects the duration of the focused sign.

To sum up, our observations on manual strategies in TİD are in line with the findings of Kimmelman (2014). Different prosodic parameters such as length, size or repetition pattern of a sign can be modified to encode focus intonation. However, we argue that increasing the duration is the ultimate goal of all these parameters. In some signs, more than one parameter can be modified to mark duration, yet their detailed analysis is left for future studies.

4.2.3. Phrase-final lengthening and the V-shaped contour

The difference in duration between focused and non-focused items was found irrespective of the syntactic role of the focused variety. This finding is in line with the findings of Kimmelman (2014). While the difference in duration was preserved across syntactic roles, the results indicate that the verb has overall significantly the longest duration. We argue that this significant difference is due to phrase final lengthening observed in sign languages. Wilbur (1999) suggests that phrase final signs are lengthened and marked as more prominent than the non-final signs. Remember that SOV order was preferred in 98% of all cases, and 16 sentences out of 720 had a different word order than SOV. In these non-canonical sentences, the duration of the last unit was $M = 0.38$ ($SD = 0.31$) while the mean duration of the first item was $M = 0.36$ ($SD = 0.16$) and the second item was $M = 0.35$, ($SD = 0.17$). The duration of the phrase final non-verbal units in these sentences indicates that phrase final lengthening is not a specific property of the verb category; that is, a subject or an object is also lengthened in the clause-final position. The other finding of this study is that irrespective of focus or the position of the arguments with respect to the verb, a V-shaped prosodic contour is observed.

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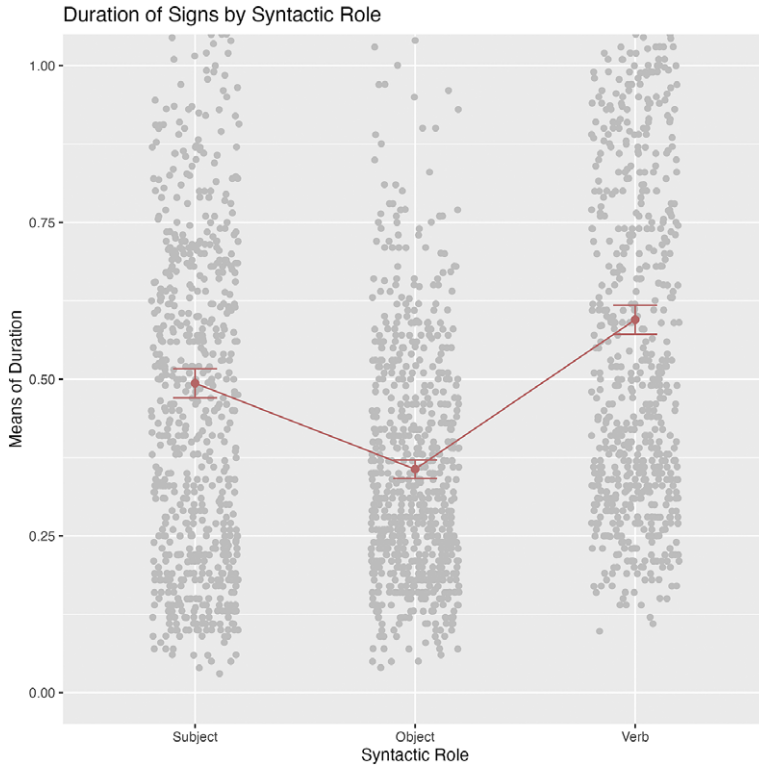

Figure 13. Duration of signs by syntactic role.

As illustrated in Figure 8, the duration of manual signs in a sentence produces a 'V-shaped contour': the object having the shortest duration between the subject and the verb, which shows typical properties of phrase final lengthening. As seen in Figure 8, this prosodic shape is preserved regardless of the syntactic role of the focused sign, and Figure 13 shows that the same prosodic shape is preserved across all data points. The interesting thing is that the non-canonical sentences mentioned above also preserve this V-shaped contour: the first constituent was long (M = 0.36, SD = 0.16), the second one was slightly shorter (M = 0.35, SD = 0.17), and the third one was the longest item (M = 0.38, SD = 0.31).

4.2.4. The signing rate

One of the research questions raised in this study is whether the signing rate influences the prosodic strategy used to mark focused constituents. Wilbur (2009) suggests that when the signing rate is increased, signers adjust sign duration, number of pauses and pause duration. In line with these findings, in the current study, the signers completed the second session in a significantly shorter period of time when compared to the first session. However, we found that focused constituents are articulated considerably longer than their non-focused counterparts in both sessions (Figure 10). Hence, we suggest that signers preserve increased duration to mark focus

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even with an increased signing rate. Manual prosody is a robust strategy to articulate focus intonation in TİD.

4.2.5. Age of acquisition effect

Finally, the duration of the focused signs is influenced by the age of acquisition of the signers. Note that both DoD and DoH signers articulate focused signs longer in duration, with DoH signers being slower than the DoD signers. However, with DoH signers, duration is also higher for non-focused signs. Hence, we conclude that, overall, DoH signers sign at a slower rate than DoD signers, and focus intonation is no exception to this pattern.

To our knowledge, other production studies have not investigated the differences between the two groups in their production for information structure. Even though it is difficult to pinpoint the reason for the difference between the two groups, a possible explanation would be that the delayed language exposure and input yield longer planning and retrieval time for their vocabulary items and sentences, thus a slower signing rate. A study using the free-recall paradigm found that late TİD signers had a lower mean number of correct responses than native signers across parameters, thus having a smaller search set in the mental lexicon (Keleş et al., 2022). Studies on other sign languages also showed that Deaf children with delayed input performed less on vocabulary production and executive function[6] tasks than hearing peers (Botting et al., 2016). The authors also found a correlation between language performance and executive function. In terms of executive function, Deaf children with early exposure to sign language were found to perform equally with their hearing peers, and authors discussed that exposure to the complex patterns in natural language may train neural circuits that are also used in nonlinguistic cognitive domains, as in goal-directed behavior and managing cognitive resources efficiently (Hall et al., 2017). Furthermore, a perception study also found that DoH participants were slower at recognizing signs (Caselli et al., 2021; Mayberry & Witcher, 2005) and participants with less signing experience in childhood were less accurate in a real and non-real sign distinction task (Caselli et al., 2021). Thus, one possible explanation for DoH participants' longer signing duration is that they need more time in the planning and signing stages; however, this issue needs further investigation.

5. Nonmanuals

5.1. Results

Tables 4 and 5 present the distribution of nonmanuals, the number of instances they accompany focus, and each nonmanual observed in the data. Nonmanuals appeared with 22% of all data points, focused or non-focused. At least one nonmanual appeared over a focused item only in 8% of the data. Head nod was the most frequently observed nonmanual marker, with a distribution of 72% of all occurrences in the data. It was followed by eyebrow raise with 29%, and squint was the least common nonmanual marker with a distribution of 5%. When their co-occurrences

[6]Executive function is briefly known as a constellation of cognitive skills that have two central components behavioral regulations enabling goal-directed behavior and controlling competing desires or impulses and metacognition allowing individuals to effectively manage their cognitive resources (Botting et al., 2016).

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Table 4. Proportions of nonmanuals and focus in the data

	Count	Percentage
Overall NMM occurrence	481/2147	22
Focus and NMM	167/2147	8

Table 5. Distribution of each nonmanual in the data

	Count	Percentage
Head nod	348/481	72
Eyebrow raise	140/481	29
Squint	25/481	5
Head nod and eyebrow raise	24/481	5
Head nod and squint	7/481	1
Squint and eyebrow raise	1/481	0.2

were counted, head nod and eyebrow raise appeared together in 5% of the data. Head nod and squint co-occurred in 1% of the data. Squint and eyebrow raise were the least common patterns with 0.2%.

A linear mixed effects model was fit to assess the fixed effects of focus, focus type, syntactic role, verb type and session on the nonmanual production over manual signs. The effects were compared to the baseline model, where participant and item were random factors. A series of models were also run to test the possible effects of confounding variables of age and age of acquisition. Age, age of acquisition, verb type and session did not have a significant effect on the production of nonmanuals. We did not test the effect of gender because the participant pool was unbalanced with 17 female participants; thus, it would have yielded a misleading effect.

The model showed no effect of focus on the nonmanual production ($X^2(1) = 0.544$, $p = .46$). As seen in Figure 14, both focus and non-focus signs yielded similar amounts of nonmanuals in all syntactic roles. Yet, syntactic roles had distinct distributions of nonmanuals. Results showed a significant effect of syntactic role in nonmanual production ($X^2(2) = 251.25$, $p < .001$).

Posthoc tests among positions showed that object yielded significantly fewer nonmanuals than subject ($\beta = -0.32$, $SE = .02$, $t = -15.90$, $p < .001$) and verb ($\beta = -0.72$, $SE = .02$, $t = -3.60$, $p = .001$). Subject yielded significantly more nonmanuals than verb ($\beta = 0.25$, $SE = .02$, $t = 12.32$, $p < .001$) (Table 6).

Session had a significant effect on nonmanual production ($X^2(1) = 4.492$, $p = .03$). Participants produced more nonmanuals in Session 1 than Session 2 ($\beta = 0.03$, $SE = .02$, $t = 2.12$, $p = .03$). Lastly, there was a significant interaction between AoA and syntactic role on nonmanual production ($X^2(3) = 14.522$, $p = .002$). DoD participants produced significantly fewer nonmanuals with the object than the subject ($\beta = -0.24$, $SE = .03$, $t = -9.09$, $p < .001$) and more nonmanuals with subject than verb ($\beta = 0.20$, $SE = .03$, $t = 7.44$, $p < .001$). DoD participants did not have a significant difference in the production of nonmanuals with object and verb. In contrast, DoH participants produced significantly fewer nonmanuals with object than subject ($\beta = -0.39$, $SE = .03$, $t = -13.22$, $p < .001$) and verb ($\beta = -0.10$, $SE = .03$, $t = -3.35$, $p = .002$). They produced significantly more nonmanuals with subject than verb ($\beta = 0.29$, $SE = .03$, $t = 9.88$, $p < .001$).

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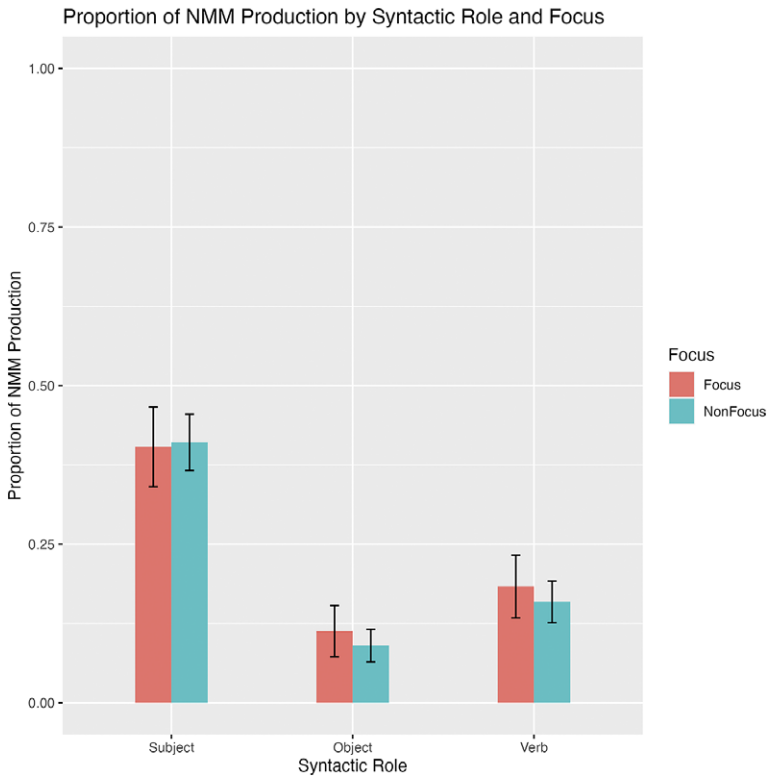

Figure 14. Proportion of nonmanual production by syntactic role and focushood.

Table 6. Posthoc results of the effect of syntactic role on the nonmanual production

Pair	*β*	*SE*	*t*-value	*p*-value
Object–Subject	−0.32	0.02	−15.90	<.001
Object–Verb	−0.72	0.02	−3.60	.001
Subject–Verb	0.25	0.02	12.32	<.001

5.2. Discussion: the puzzle of nonmanuals

5.2.1. Focus and nonmanuals

As the results indicate, nonmanuals do not necessarily accompany focused signs in TİD. This is in contrast to the classification suggested in the literature according to which the nonmanuals are analyzed as expressions of intonation (Brentari & Fenlon, 2020; Brentari et al., 2015; Dachkovsky & Sandler, 2009; Nespor & Sandler, 1999; Sandler, 1999, 2012). The link between nonmanuals and intonation has already been suggested for TİD. Göksel and Kelepir (2013) found that head tilt marks the type of the clause as an interrogative, and the orientation of head tilt, together with the movement pattern of head, differentiates content questions from polar questions. Hence, nonmanuals are not excluded from the articulation of intonation in TİD. However, the results of the current study indicate that nonmanuals do not necessarily

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contribute to the focus intonation. The distribution of the nonmanuals does not necessarily overlap with focused constituents of any type. In (15a), the subject bears focus, and it is marked with the nonmanual squint. In (15b), the same constituent is co-articulated with the same nonmanual marker, although it is non-focused. Our findings are similar to those of Gürer and Karabüklü (2022) in that the alignment of the nonmanuals with the manual signs is not related to focushood.

(15) a. sq
AYŞE$_{FOC}$ PENCIL THROW
'Ayşe throws the pencil.'

b. sq
AYŞE PENCIL$_{FOC}$ THROW
'Ayşe throws the pencil.'

5.2.2. Syntactic role and nonmanuals

Similar to the multimodal prosodic structure in the speech-gesture domain, we were expecting a multichanneled prosodic structure for focused signs in TİD; however, there is a division of labor instead. Manual prosody effectively marks focused signs without an accompanying nonmanual. This contrast between spoken and sign languages is interesting in the sense that in spoken languages, all the available tools across modalities (speech and gesture) are used to encode the focus prosody. TİD has a single modality and two channels, and it opts for using only one of the available tools to mark focus prosody. This brings up a critical question: what exactly is the function of nonmanuals then? A comprehensive answer is beyond the scope of this article, but we will speculate on a few possible explanations: (i) nonmanuals are only secondary cues in the articulation of focus, or (ii) they have a different function than focus intonation.

If the first hypothesis is on the right track, why do not we observe more accompanying nonmanuals with focused signs? We suggest that one of the factors can be the length of the target sentences used in the current study. In spoken languages, Watson and Gibson (2004) observe that prosodic markers are more frequently found after long constituents. In the current study, all the sentences had only a subject and an object as the arguments of the verb. Additionally, focused signs in the current study do not appear with focus particles or syntactic structures encoding focushood, such as cleft constructions. There are studies in the sign language literature reporting nonmanuals with specific focus structures like cleft constructions (Wilbur, 1994) or focus particles (Herrmann, 2015). If nonmanuals in TİD appear with specific focus constructions or in longer sentences, this may be a reason for low nonmanual production in the current study. These hypotheses need to be tested in new experimental studies.

The other hypothesis is that nonmanuals do not accompany focused signs but signal the edge of a domain, including a focused sign, as already suggested by Gürer and Karabüklü (2022). The following example (16) from our data set cast doubt on this hypothesis in that when the verb bears focus, the nonmanual marker does not necessarily mark the edge of this constituent.

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(16) a. hn hn
AYŞE PENCIL THROW$_{FOC}$
'Ayşe throws the pencil.'

b. hn
AYŞE PENCIL THROW$_{FOC}$
'Ayşe throws the pencil.'

We revise this hypothesis in the following way: the nonmanuals can signal the edges of prosodic groupings, but the focus may not shape this grouping. Hence, there is no correlation between the nonmanuals and the edge of the grouping, including the focused sign as exemplified in (16). If it is not focus that shapes the grouping, then speech rate is another candidate. It is well-known that speech or signing rate influences the number of prosodic groupings (Nespor & Vogel, 1986; Wilbur, 2021). In the current study, we found that fewer nonmanuals appeared in the second session than in the first session, and the difference is significant. Remember that the duration of manual signs in the second session was also significantly shorter than in the first session. The presence of the nonmanuals can signal the edges of the prosodic grouping, but as the signing rate increases, the number of the groupings will decrease. Constituents that would appear in separate groupings will end up in a single grouping, and hence, we observe this variation in groupings. A more systematic investigation of this hypothesis is also left for future studies.

5.2.3. Age of acquisition effect

Lastly, there is a significant interaction between the age of acquisition and the syntactic role of nonmanual production. That is, both groups produced more nonmanuals with the subject than object and verb. The difference between the production of nonmanuals with object and verb is not significant for DoD participants, yet it is a significant difference for DoH participants. In the literature, for the effect of age of acquisition on information structure, it is reported that adolescent acquirers produced fewer eyebrow raise with topic structure than early learners in ASL (Cheng & Mayberry, 2019). In the current study, DoH participants may have produced more nonmanuals because they were exposed to TİD approximately at the age of 7 before adolescence. It has also been found that neural processing of nonmanuals with topic structures in Austrian Sign Language (ÖGS) was increasingly delayed when the age of acquisition of the participants was increased (Malaia et al., 2020). Similarly, another study tested if the age of acquisition affected the grammaticality judgments of stimuli where nonmanual information was incrementally presented in Polish Sign Language (PJM) (Tomaszewski et al., 2022). Although all participants, including the native signers, had difficulty in detecting violations in nonmanual stimuli, signers with increased age of acquisition had more difficulty 'for multi-channel signs that required signers to split their attention between manual and non-manual features of the stimuli' (Tomaszewski et al., 2022, p. 10). Incremental difficulty in the perception and processing of nonmanuals with the age of acquisition suggests that our DoH participants are similar to the child acquirers who started to receive critical input for the role of nonmanuals. However, they are not as advantageous as DoD participants. Thus, DoH participants may overproduce them along with hyper-articulation of duration to compensate for increasing information load for their interlocutors, yet this needs to be further tested with both groups as well as the role of nonmanuals.

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6. Conclusion

We aimed to investigate how focus shapes the simultaneous, multi-channel structure of sign languages, taking TİD as our testing ground. A controlled production study was carried out to investigate if focus affects the duration of manual signs and the production of nonmanuals in TİD. The results of duration measurements showed that TİD signers produced manual signs longer when they were focused. The investigation on the production of nonmanuals showed that focus did not have a significant effect on the nonmanual production; in contrast, the syntactic role was a better predictor for the appearance of nonmanuals.

The main findings of the current study are in contrast with the prosodic mechanism suggested in the literature. Intonation in sign languages is suggested to be primarily marked via nonmanuals and constituent hierarchy via manual markers (Brentari & Fenlon, 2020; Brentari et al., 2015; Dachkovsky & Sandler, 2009; Nespor & Sandler, 1999; Sandler, 1999, 2012). Hence, nonmanual prosody is an outstanding candidate for focus intonation. In contrast to this proposed division of labor, TİD relies on manual prosody for focus intonation. Additionally, it is not focushood but the syntactic role that is a significant predictor for nonmanual marker production. One can suggest that we see the mirror image of the proposed division in the literature; that is, focus intonation is marked in the manual domain, while prosodic constituent hierarchy based on the syntactic structure is marked in the nonmanual domain. As the same pattern is also observed in RSL, we suggest that whether focus is marked in the manual, nonmanual channel or both channels is a matter of typological preference. Even though there are not many studies on the manual prosody in sign languages and how it interacts with nonmanuals, Kimmelman (2014, p. 130) notes a similar division in typologically different RSL and NGT and suggests that 'RSL seems to be a manual-dominant language in this domain, barely using nonmanuals. NGT is not exactly nonmanually-dominant, but it does use some nonmanuals of focus regularly.' TİD shows similarities with RSL in that the manual channel is used to encode focus intonation. We believe that future studies on typologically different sign languages will shed further light on the typological picture of how information is organized in the simultaneous structure of sign languages.

When we compare sign languages to spoken languages in a larger framework with respect to the organization of simultaneity, speakers use multimodal strategies to convey prominence when the resources are available. In contrast, there is a split in sign language typology with respect to the usage of simultaneous strategies. Some languages, like NGT, pattern with spoken languages by using both manual and nonmanual channels. In contrast, some languages like RSL and TİD opt for one channel, namely manual one. This fundamental difference in the multimodal prosody of spoken languages and the multichannel prosody of sign languages can be due to how simultaneity is shaped to convey information in these language systems. In spoken languages, simultaneity is realized in two modalities, speech, and accompanying gestures, while it is realized in a single modality with two possible channels in sign languages, possibly yielding differences in the organization of information load.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/langcog.2024.4.

Data availability statement. The anonymized raw results and R script used for the analysis of this study can be found in the following OSF repository: https://osf.io/jp2k6/?view_only=35d022ef53fc43cd8f1647951c91c7aa.

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