Central Taurus Sign Language: On the Edge of Conventionalization

Rabia Ergin, Leyla Kürşat, Ethan Hartzell, and Ray Jackendoff

Author Note

Rabia Ergin is a research group leader at Boğaziçi University; Leyla Kürşat is the lab manager of the ALPS lab at the Department of Linguistics, Stanford University; Ethan Hartzell is a CASA fellow at the American University in Cairo; Ray Jackendoff is Seth Merrin Professor of Philosophy Emeritus at Tufts University and Research Affiliate in the Department of Brain and Cognitive Sciences at MIT.

Correspondence should be e-mailed to Rabia Ergin, e-mail: rabia.ergin@gmail.com

Abstract

We discuss the conventionalization process in Central Taurus Sign Language (CTSL), an emerging sign language in its initial stages, and present evidence from four studies for the amount of lexical and structural variation it harbors. The four studies together portray the architecture of a young system under construction. Study 1 looks at signs for everyday objects and finds considerable variation in their degree of conventionalization. Study 2 examines modifier-head and negation-head relationships, showing substantial conventionalization. Study 3 addresses the emergence and conventionalization of various word orders as argument structure markers. It shows that conventionalization increases over successive cohorts of signers, but it decreases as argument structure becomes more complex. Study 4 demonstrates the emergence and conventionalization of distinctive morphological markers to signal the subtle semantics of symmetry and reciprocity. Finally, we raise the issue of whether CTSL presents evidence of syntactic structure, or whether its properties can be characterized in terms of a simpler “linear grammar” that maps directly between phonology and semantics.

Central Taurus Sign Language: On the Edge of Conventionalization

1. Introduction to CTSL

Central Taurus Sign Language (CTSL) is a village sign language used in three small villages in the south of Turkey. According to our best guess, this language has sprung up spontaneously over the past 50 years or so, in the absence of a conventionalized language model. The language currently has about 25 deaf signers, 17 of whom use CTSL as their sole language. In addition, there are approximately 80 hearing Turkish speakers who also have some degree of fluency in CTSL. The majority of CTSL signers live in one of the three villages (deaf population = 4.6%);¹ a very few live in the other two (deaf population = 0.7% and 0.5%).

For methodological convenience, we identify three cohorts of signers in the community. The first cohort of signers (CTSL-1) comprises the individuals who were the first deaf child in their family, and who therefore would have had little or no linguistic input early in life ($n = 9$; age range = 41-53). The second cohort (CTSL-2) is constituted of the younger siblings of cohort 1 signers; they would have had more linguistic input because they had an older sibling who signed ($n = 8$; age range = 34-45). The third cohort of signers (CTSL-3) is composed of signers from the younger generation: children of CTSL-1 and CTSL-2 signers ($n = 4$; age range = 16-22) (see Ergin, 2017; Ergin & Brentari, 2017; Ergin, Meir, Ilkbaşaran, Padden, & Jackendoff, 2018; Ergin, Senghas, Jackendoff, & Gleitman, 2018). There are also 4 deaf children who constitute a potential fourth cohort; we have not yet investigated their language use.

CTSL, along with other emergent sign languages, raises a host of issues about language acquisition, language change, and the nature of the human language capacity. We begin with a discussion of the issues at stake. We then present four elicitation studies that

¹ The first author is a native member of the CTSL community in this village.

bear on various aspects of CTS� signers' mental grammars, and conclude with some discussion of the status of syntactic structure in CTS�.

2. What is involved in conventionalization, and what is conventionalized?

A fundamental question of linguistics is how a language is acquired. The commonsense answer is that children imitate and generalize over the primary linguistic input. A major concern of linguistic theory since Chomsky (1965) has been to determine the degree to which language acquisition requires the use of an innate domain-specific cognitive capacity, that is, whether the "language-ready" brain has to know something specific about language in advance. We will not rehearse those arguments here, except to state that (in our opinion) some such capacity is necessary, and its character is an empirical question (see Culicover & Jackendoff, 2005; Jackendoff, 2002).

One of the most striking pieces of evidence for a (partly) domain-specific language faculty comes from deaf children raised in the absence of an accessible sign language. The only input such children have is comparatively unstructured co-speech gesture. Yet they construct home signs: systems of communication that are considerably more elaborate and language-like than anything coming from the parents (as painstakingly documented in practically every paper by Goldin-Meadow and colleagues). In fact, the parents often fail to appreciate the child's systematicity. Hence the home sign is in effect a language with only one competent user; there is no one from whom the child has learned it (e.g., Carrigan & Coppola, 2012; Coppola & Newport, 2005; Feldman, Goldin-Meadow, & Gleitman, 1978; Franklin, Giannakidou, & Goldin-Meadow, 2011; Goldin-Meadow & Mylander, 1990, 1998).

Something more than home sign comes about when there is a community of deaf individuals. As is known from Nicaraguan Sign Language, which has been studied almost since its inception in the late 1970s, elaboration of a sign system begins almost immediately, and continues through successive cohorts of learners (e.g., Senghas, 1995; Senghas &

Coppola, 2001; Senghas, Kita, & Özyürek, 2004; Senghas, Newport, & Supalla, 1997).

Interestingly, earlier cohorts preserve (some of) the features (or limitations) of earlier phases of the language –as is known to be the case with language change in general (Labov, 1994).

Hence the development of the language over time can be partially reconstructed from the current usage of signers who belong to different cohorts, i.e. who acquired the language at different times.

How do these elaborations come about? The commonsense answer is that they become *entrenched* in the minds of individual speakers, and *conventionalized* across the community (e.g., Bybee, 2006). We will show here how CTSL gives us a snapshot of a language in the process of conventionalization.

What does it mean to say that some feature F of a language – a word or a phonological, syntactic, morphological, or pattern – is conventionalized? Basically, the idea is that F is a part of everyone’s knowledge of language. Conversely, to say F is not (yet) conventionalized is to say that speakers/signers in the community differ in whether F is part of their knowledge. We can further think informally of degrees of conventionalization –how widely F is shared across the community. In order to study the process of conventionalization, then, we have to set aside the standard idealization of grammar to “ideal speakers in a homogeneous speech community,” and acknowledge that different individuals have different grammars. But then, we might be led to ask, are they even “speaking the same language”? The best we can say is that despite having different systems, which we might call CTSL_a, CTSL_b, etc., the systems are sufficiently alike that individuals manage to understand each other without particular effort.² In our view, the variation we find in CTSL and demonstrate here is just a hugely magnified version of individual variation in any language community. There is no bright line between “the same” and “different” languages.

² We make such a division below in speaking of the differing grammars of the three cohorts of CTSL signers. This division, as mentioned above, is a matter of methodological convenience: typically, each speaker has his or her own variant, as will be seen below.

Just to be a little pedantic about the mechanism behind conventionalization: the process has to begin with some single user of the language, who improvises a structure hitherto not possible within his/her grammar, remembers it (consciously or unconsciously), and comes to use it repeatedly and consistently (i.e. it becomes entrenched for that person). In the context of a community, someone else understands this new structure (creates a corresponding mental representation), remembers it, uses it again, conveys it to someone else, and so on, until it is present in the grammars of the whole community.

If there is already a conventionalized way, feature G, to say what is conveyed by the newly introduced feature F, then F is in competition with G. Hence F can only increase in frequency at the expense of G. For an individual speaker, this means that F and G coexist in the grammar, with some ratio of relative lexical strength (possibly instantiated as resting activation in memory). This is of course a general story for language change (e.g., Croft, 2000; Heine & Kuteva, 2008; Mufwene, 2001; Sankoff, 2002). The difference in emerging sign languages is that new features typically step into a vacuum – there is nothing to compete with – and they make it possible to say things more precisely or expressively than before. The rich possibilities afforded by the potential iconicity of gesture encourage such inventions, as well as their propagation in the community.³

Turning to the phenomena reported here, we present the results of four experimental studies on different aspects of CTSL lexicon and grammar. Study 1, a picture-naming task, presents evidence for roughly three classes of responses:

- Everyone used the same sign for the picture in question. In this case, we would want to say this sign is fully conventionalized.

³ It should be borne in mind that improvisation does not always lead to change. As pointed out by Poplack and Dion (2012) for loanwords, the vast majority of improvisations are one-off and do not spread throughout the community. The dynamic is such that very few novel variants survive.

- Everyone used a different sign or sequence of signs for the picture in question. In this case, we would want to say there is no conventionalized sign with this denotation, and each signer is improvising a description of the object.
- In between: There are a variety of responses, but they share some of their components, sometimes in the same order, sometimes not. For these cases we might want to say they are partially conventionalized, according to various criteria that we will describe in the next section.

Study 2 examines the placement of modifiers and negation with respect to what they modify. This aspect of the language seems to have achieved a significant degree of conventionalization in the order of modifiers and the entities being modified, with not too much difference across cohorts.

Study 3 concerns the use of word order to express argument structure, for instance, whether Agent and Patient are always expressed in the same relative position. Here we see a demonstrable cline of conventionalization.

- In descriptions involving single-argument actions such as walking or falling, there is a fair degree of uniformity across cohorts.
- In describing two-argument actions such as hitting and pushing, the earliest of the three CTSL cohorts is comparatively unsystematic, while the latter two tend toward greater systematicity.
- But in describing three-argument actions such as giving and handing, all three cohorts are unsystematic. Evidently they have no conventionalized patterns to fall back on, and so everyone is improvising.

Study 4 concerns the expression of symmetrical predicates like *shake hands* and *high-five*, and that of reciprocal predicates such as *hug each other* and *dance with each other*. In the former case, the action cannot be performed by a single individual; in the latter, each

individual can perform the action independently, but the two individuals happen to be acting on each other. Nicaraguan Sign Language has been shown to give special treatment to these delicate semantic distinctions (cf. Flaherty, Goldin-Meadow, Senghas, Coppola, & Gleitman, 2013, 2014), so it is of interest to see if CTSL does as well. And indeed it does, appearing as distinct morphological modifications of the predicates in question, through with different realizations than in NSL.

3. Study 1: Lexical variation

The first experimental study examines and quantifies lexical variation across the small community of CTSL signers. Although mature languages always display some degree of variation (e.g., Dąbrowska, 2018), CTSL is remarkable in its mixture of more or less conventionalized signs or sign sequences, improvised sign sequences, and competing lexical variants. In particular, we will see that there are many lexical gaps: common objects for which there appears to be no conventionalized sign at all.

The huge variation across the CTSL lexicon seems to be characteristic of emerging languages. It has also been observed in Al-Sayyid Bedouin Sign Language [ABSL] (Sandler, Aronoff, Meir, & Padden, 2011), San Juan Quiahije Chatino Sign Language [SJQCSL] (Hou, 2016), and Nicaraguan Sign Language [NSL] (Senghas, Senghas, & Pyers, 2005). Moreover, CTSL signers string together both conventionalized and improvised signs to name and describe objects. Such sequences have also been described in ABSL (Meir et al., 2010), SJQCSL (Hou, 2016) and in the sign language of Amami Island in Japan (Osugi, Supalla, & Webb, 1999).

Various factors are responsible for variation in sign languages. For example, in British Sign Language (BSL), a fully-fledged macro-community, Stamp, Schembri, Fenlon, and Rentelis (2015) find that age, school location, and whether family members are deaf or

hearing are significant predictors of a signer's lexical choices. In micro-community sign languages such as SJQCSL (Hou (2016), ABSL (Sandler et al. (2011), and Amami Island sign (Osugi et al. (1999), variation frequently occurs from one family to the next.

One pattern that frequently emerges in early stages of a young lexicon is compounding. For instance, Morford and Kegl (2000), describing precursors to compounding in a home-sign system of Nicaragua, find that in a picture-naming task involving fruits, signers may produce either a gesture for eating, a gesture indicating how the fruit is prepared, or a compound consisting of a sequence of the two. Similar variations have been reported in the compounds created by the deaf communities in Chatino of Mexico (Hou, 2016) and Amami Island (Hou, 2016; Osugi et al., 1999, respectively), as well as in ABSL (Meir, Aronoff, Sandler, and Padden (2010). Morgan (2015) finds that some compounds in Kenyan Sign Language such as TASTE^SPRINKLE ("salt") and BLACK^PEAR-SHAPE ("avocado") have conventionalized order among their components. But other compounds are less conventionalized, for instance 'candle' may be expressed by FLAME^STRIKE, STRIKE^FLAME, or longer sequences with other elements in variable orders, with some items repeated multiple times.

We expect the distribution of CTSL's lexical variation to resemble that of these other micro-community sign languages.

3.1. Method

Participants. The participants who participated in all four studies are listed in Appendix A, along with their cohort, gender, age, village of residence, education, and familial relationships.

The present study involved 13 deaf CTSL signers: $M_{\text{age}} = 40.8$; Range: 53-16, seven females and six males. (The mean age and the age range correspond the ages of the participants when they were tested in August 2013.)

Stimuli. The stimuli were digital images of 15 common objects around the village and household, plus 23 familiar fruits, vegetables, and other food items (see Appendix B).

Task. Participants performed a picture-naming task. All of the stimuli were pictured as they appear in villagers' daily lives. They were asked to tell a CTSL-fluent interlocutor what each depicted object was.

Coding Procedure. In categorizing signed responses, we considered two responses to a stimulus different if they represented the object in question in different ways. For example, iconic signs depicting eating a melon and iconic signs depicting the shape of a melon were not transcribed as MELON, but as EAT-MELON and ROUND respectively. (The words separated by a hyphen represent one sign and not two.)

On the other hand, even in the responses that we considered the same, there was often noticeable variation in location, movement, and handshape. Figure 1 shows four realizations of 'match.' We counted them as the same, because they all pick out the same facet of the object to represent iconically: the dominant hand strikes the nondominant hand as one would strike a match against a matchbox.⁴

⁴ The oldest signer produces a form without matching handshapes (the non-dominant hand has a handshape different than that of the dominant hand), and with a longer motion, repeated twice. The second signer has matching handshapes, but on the repetition of the motion changes the handshape of her non-dominant hand to a more lax shape. The third signer has matching handshapes and repeats the movement twice. The fourth signer has clearly matching handshapes with the selected fingers most easily distinguishable; she repeats the movement many times, with a shorter, tenser movements.

In a similar study of variation in picture naming in Kenyan Sign Language, Morgan (2015) treats such phonetic variants as distinct signs. Our coding corresponds to Morgan's "broader" level of conventionalization. Coding according to her "finer" level would result in far more variation, as seen in Figure 1.

Figure 1. The sign MATCH produced by different members of a family: oldest sibling (P1), middle sibling (P7), youngest sibling (P10), and daughter of youngest sibling (P14).

We analyzed the two stimulus sets (household items and fruits and vegetables) in the picture-naming task separately, to see if there were any significant differences based on semantic category. The two categories in fact had about the same profile, so we combine their results.

3.2. Results

Number of variants

The most obvious criterion for conventionalization is the *number of variants* produced by the 13 subjects. Intuitively, if every participant produces the same sign S for an object O, then S is a conventionalized expression for O.⁵ Only two of the stimulus objects, ‘match’ and ‘spoon’, met this criterion. And even here there was noticeable variation with regards to location, movement, and handshape, as illustrated in Figure 1.

On the other end of the spectrum were objects for which (to our surprise) each of the 13 participants produced a different sign or sign sequence: ‘gas tank’, ‘walnut’, ‘potato stew’, ‘melon’, ‘quince’, and ‘watermelon’. In these cases, there clearly is no conventionalized sign. Table 1 shows the responses to ‘gas tank’.

⁵ A reviewer has pointed out the possibility that the signers all happen to spontaneously improvise the same sign, especially when it is iconic. We have no way to control for this, but consider it unlikely, given the degree of variation found with other items.

Table 1

Variants of 'gas tank' produced by each signer. Prosodic breaks are indicated by slashes.

<u>Responses to 'gas tank'</u>
1. BLOW FLAME
2. POT-PUT MATCH FLAME
3. SWITCH TALL WIDE
4. SWITCH TALL / TALL SMELL / SWITCH / SWITCH TALL SWITCH
5. TALL SWITCH
6. SWITCH FLAME
7. FLAT SWITCH FLAT
8. SWITCH / SWITCH
9. MATCH FLAME WIDE
10. MATCH SWITCH
11. SWITCH FLAME SWITCH
12. SMELL COOK POT-PUT
13. SWITCH FLAME / FLAME

Some of these responses may be compounds (e.g., SWITCH FLAME). Others have the flavor of a one-off description of how one uses the object; for instance, Response 4, with its prosodic complexity, favors the latter. But in general, it is difficult to make a sharp distinction. The basic point is that there does not appear to be a conventionalized sign or sign sequence for 'gas tank.' On the other hand, the responses in Table 1 share a number of constituent signs such as FLAME and SWITCH, and this might be a factor in conventionalization. We return to this issue shortly.

In between the two objects with fully conventionalized signs and the six objects with thirteen different responses, the remaining 30 objects elicited differing amounts of variation in their responses, ranging from 3 variants ('glasses' and 'car') to 12 ('cologne' and 'cooking pot'). The first column of Table 2 shows the number of variants for each of the stimulus objects. Intuitively, the fewer variants, the more conventionalized the expression(s) for the object in question.

Table 2.

Number of variants (left-hand column) and mode of variants (right-hand column) for lexical items in Common Objects and Fruits/Vegetables datasets, across 13 CTSL signers.

Stimulus	Number of variants	Mode of variants	Stimulus	Number of variants	Mode of variants
Spoon	1	13	Tomato	9	5
Match	1	13	Olives	9	5
Glasses	3	9	Cucumber	9	4
Car	3	8	Plum	9	2
Watch	4	9	Sunflower oil	9	2
Salt	5	8	Plate	10	5
Flour bowl	5	7	Glass	10	3
Fork	5	6	Onion	11	3
Squash	5	5	Pepper	11	3
Soap	6	7	Garlic	11	2
Sugar	6	5	Feta cheese	11	2
Tea	6	5	Cologne	12	2
Apple	7	7	Cooking pot	12	2
Grapes	7	6	Quince	13	1
TV	7	4	Watermelon	13	1
Egg	8	5	Gas tank	13	1
Fig	8	3	Walnuts	13	1
Potato	9	6	Potato stew	13	1
Teapot	9	5	Melon	13	1

We can ferret out some further details of conventionalization. Consider for instance ‘potato’ and ‘plum’. They each have 9 variants, so on the previous measure they are equally conventionalized. However, the most frequent variant for ‘potato’ occurs 6 times, while the most frequent variants of ‘plum’ occur only twice. This suggests that the most frequent variant for ‘potato’ is closer to conventionalization than that for ‘plum’.

A somewhat crude measure of this uniformity or lack thereof, employed by Meir et al. (2010), counts the *number of responses using the most frequent variant*, that is, the *mode of variants*. The intuition is that the more that participants produce the most frequent variant, the more conventionalized that variant is for referring to the object in question. The mode of variants for the 38 objects appears in the second column of Table 2. The higher an item’s mode of variants, the closer that variant is to conventionalization, and the more other variants can be considered relative outliers.⁶

⁶ A more sophisticated measure might measure the entropy of the set of responses; we set this possibility aside, particularly considering the relatively small data set.

Within multi-sign responses, it is possible to define a further possible component of conventionalization. Consider again ‘gas tank’ in Table 1. The component SWITCH occurs 8 times among the 13 variants (excluding repetitions); FLAME occurs 6 times; and so on down to BLOW, FLAT, and COOK, which occur only once each. We are therefore inclined to see SWITCH as the most conventionalized component of ‘gas tank’. Notice that MATCH is highly conventionalized on its own, as seen above, but it appears only three times as a component of ‘gas tank’, so its role in this function is not highly conventionalized.⁷

To give a better feel for the scope of variation, we briefly mention a few further representative examples. One of the more highly conventionalized lexical items across signers is ‘glasses’. Most signers use a single sign, and those who use a sequence of signs always include a component in which the hands are iconic of the shape of the glasses and the location of the sign is iconic of where a person wears glasses. Table 3 shows the variants, and Figure 2 shows one CTSL response.

Table 3

Variants for ‘glasses’ across signers, with most frequent component in bold.

<u>Variants of ‘glasses’</u>	<u>Frequency</u>
1. LENSES	9
2. LENSES TEMPLES	2
3. EYES LENSES	2

⁷ In dealing with these effects, it is again difficult to tell the degree to which participants’ responses were similar due to linguistic conventionalization, as opposed to the relevant aspects of the objects being sufficiently salient as to lead to convergence. However, on the latter account, it is not clear why, say, items as alike as ‘fork’ and ‘spoon’ should be perceptually and/or functionally different to such a degree that their distributions in Table 2 should be so different.

Figure 2. LENSES (left) and a tracing sign TEMPLES (right).

Thus we might want to consider LENSES as a highly conventionalized *component* of the sign for glasses, more so than the variants themselves.

For another example, the stimulus ‘teapot’ elicited 9 variants; all but 2 included a component glossed in Table 4 (below) as TEA and shown in Figure 3. This sign therefore might be considered a highly conventionalized *component* of ‘teapot.’

Table 4

Variants of the compound ‘teapot’. TEA is in bold and signs representing the shape of the pot are in italics.

<u>Variants of “Teapot”</u>	<u>Frequency</u>
1. TEA ONE-ON-ANOTHER	5
2. TEA ONE-ON-ANOTHER FLAME	1
3. TEA DRINK / TEA DRINK	1
4. TEA TALL / TEA TALL	1
5. TALL	1
6. FLAME PUT-ON ONE-ON-ANOTHER	1
7. TEA POUR-FROM-HANDLE ONE-ON-ANOTHER	1
8. TEA POUR-FROM-HANDLE	1
9. DRINK FLAME HOLD.CUP	1

Figure 3. The stimulus 'teapot' and the compound TEAPOT as it is signed in CTSL (TEA ONE-ON-ANOTHER)

Looking next at the nine variants: TEA comes first (if present), and it is usually followed by a sign describing the shape of the pot, either ONE-ON-ANOTHER or, in one case, TALL. In these cases as well as variant 4, the utterance looks like a compound. On the other hand, in variants 6, 9, and possibly 7, signers appear to be giving a description of the object rather than labeling it with a compound, e.g. variant 6: “(There is a)⁸ flame, (you) put something on (it), (it is) this shape”; and variant 9: “(You) drink (it) (after) (you) flame (i.e., cook it), (you) hold (it) (in a) cup.” Again, especially for the compound-like responses, it is hard to determine whether these variants are entrenched for their respective speakers or whether they represent one-off description.

A little suggestive evidence comes from an unplanned source: 8 of the objects and food items also appeared in Study 2, which was designed to elicit descriptions of events involving people and objects. Hence the signs for these items were used in a sentential context. This enables us to ask, for this limited collection of stimuli, how consistent signers were in their production. Table 5 compares the variation of these 8 items in the picture-naming task and in the event elicitation task.

⁸ The English text in parentheses is not represented in the sign, but represents our interpretation of the CTSL utterance.

Table 5

Comparison of variation in lexical items used in isolation (i.e., picture-naming task) vs. in context (i.e., event elicitation task used in Study 2).

Stimulus	Picture naming task (13 participants)		Event elicitation task (12 participants)	
	Number of variants	Mode of variants	Number of variants	Mode of variants
Glasses	3	9	1	12
Apple	7	7	2	7
TV	7	4	4	6
Teapot	9	5	7	3
Glass	10	3	6	3
Plate	10	5	6	4
Onion	11	3	8	4
Watermelon	13	1	3	10

As can be seen in Table 5, the variants recorded in the event elicitations are overall more uniform than in the picture-naming data, on the whole with significantly fewer variants ($t(7) = 3.98, p = 0.0053$) and higher modes. The variants used in the event elicitations contain the same components found in the picture-naming data; however, some sequences are shorter and omit some descriptive components present in the picture-naming data. For instance, the responses to ‘watermelon’ in the event elicitation data lack any variants indicating “redness,” which occurs in the picture-naming responses; and the event elicitation responses for ‘glasses’ are completely uniform, using only the sign LENSES and never including TEMPLES or EYES, as occurred in the picture-naming responses. This suggests that to a certain extent, participants in the picture-naming task are indeed elaborating their responses in order to be more descriptive. On the other hand, there is still a great deal of inter-individual variation.

3.3. Discussion

Despite the small number of deaf signers, there is substantial variation in the vocabulary for objects and food items, similar to that found in other village sign languages (see beginning of this section). Some everyday objects and food items have a (relatively) conventionalized sign. Others have no fully shared name, and in the picture-naming tasks, participants have instead produced descriptions. Still, these descriptions typically involve shared components that are to some degree conventionalized.

Despite this rather fragmentary organization of speakers' lexicons, communication appears generally to be successful, possibly mediated by iconicity. In addition, the small community size allows signers to gain familiarity with each other's idiolects, and to make use of shared knowledge of the inhabited space to facilitate the inferences about what is being talked about.

4. Study 2: Modification Strategies

This study investigates the expression of modification in CTSL, focusing on the linear sequencing of the modifier and the modified. A further goal is to investigate whether CTSL responses demonstrate variability across individual and cohorts of signers. Like spoken languages, many established sign languages have a standardized word order to express modification. In American Sign Language, for instance, most modifying adjectives appear prenominally, while lexical markers for negation (e.g., NOT, NONE) appear postnominally (Fischer, 2006). In Italian Sign Language, modifiers follow the noun (Bertone, 2009); in Russian Sign Language, the reverse order is also considered grammatical (Bertone, 2009; Kimmelman, 2012). In Turkish Sign Language, the dominant word order is head-modifier (Kubuş, 2008), and negation is expressed by a lexical marker immediately following the predicate it negates: both are accompanied by non-manuals (Zeshan, 2006).

Of course, village sign languages, like mature languages, differ in their use of word order for modification. For instance, Sandler, Meir, Padden, and Aronoff (2005) report that in ABSL, modifying adjectives, negation markers, and numerals all tend to follow what they modify. On the other hand, De Vos (2012) presents evidence for variable adjective-noun and noun-adjective constructions in Kata Kolok. Even in homesign systems, some signers are found to have a tendency to use certain word orders when expressing modification. For instance, a longitudinal study of a child homesigner by Hunsicker and Goldin-Meadow

(2012) shows that he used head-modifier order 71% of the time. This suggests that entrenchment of a canonical word order for modification sets in quite early, a conclusion consistent with the results of the present study.

4.1. Method

Participants. 12 deaf CTSL signers were tested for this study. They were grouped in three cohorts, following the rationale given in section 1: 4 CTSL-1 signers [$M_{age}=47.4$, Range=42-54, 2 females, 2 males], 6 CTSL-2 signers [$M_{age}=41.17$, Range=35-46, 4 females, 2 males], and 2 CTSL-3 signers [$M_{age}=18.5$, Range=17-20, 2 females]. The mean age and the age range correspond to the ages of the participants when they were tested in August 2014.

Stimuli. We created a set of stimuli consisting of 19 short clips, designed to reveal how signers distinguish between the members of the same semantic category (see Appendix C). Three of the clips involved distinctions of size and/or location (e.g. there are a big book and a small book, and the man takes the small book). The remaining sixteen involved two human characters distinguished by their appearance (e.g. there are two women, and the woman with the hat rolls the ball). In order to disambiguate their descriptions, participants had to produce expressions that included modifiers.

Task. Signers viewed video clips on a computer screen and described what they saw to a deaf addressee, who then selected the corresponding picture from an array of three pictures as a comprehension check (see Appendix D). All clips were shown in the same randomized order and participants' descriptions were recorded on video. If the addressee did not choose the correct picture, the signer was given up to two more tries; hence some of the participants produced more than one response.

Coding Procedure. In the simplest cases, a single modifier was adjacent to its head. We called this case *simple modification*, and we coded the relative order of modifier and head as

either Mod-H or H-Mod. In response to the video clip depicted in Figure 4, the CTSL utterance given in (1) demonstrates simple modification; the order is H-Mod.

Figure 4. Stimulus item: The woman with the hat rolls the ball.

- (1) CTSL: TWO WOMAN SIT / WOMAN HAT THROW-BALL
English: Two women sit. (The)⁹ woman (with the) hat throw(s) (the) ball.

However, many cases of modification involved multiple modifiers. We identified three such complex configurations. In the first configuration, *conjoined modifiers*, multiple modifiers modify the same head, as in English *tall beautiful woman*. For example, in response to the video clip depicted in Figure 5, the CTSL utterance in (2) demonstrates conjoined modifiers of MAN.¹⁰

⁹ Again, the text in parentheses does not come from the actual CTSL utterance. It is our interpretation in English of the meaning of the CTSL utterance.

¹⁰ This stimulus was designed to elicit a contrast between the two books on the table. However, in response (2), the participant has unexpectedly has also produced modifiers on MAN.

Figure 5. Stimulus item: The man who is wearing a shirt and glasses takes the big book and goes away.

- (2) CTSL: MAN SHIRT GLASSES / BOOK TABLE BOOK BIG TAKE
English: (The) man (with) shirt (and) glasses take(s the) big book.

In the second complex configuration, *semantic embedding*, a second modifier modifies the first modifier, as in English *red-shirted man*. For example, in response to the video clip depicted in Figure 6, the CTSL utterance in (3) demonstrates semantic embedding.

Figure 6. Stimulus item: The man with the red shirt rolls the ball.

- (3) CTSL: MAN SHIRT RED/ MAN THROW-BALL
English: (The) man (with the) red shirt, (that) man throw(s) (the) ball.

Finally, *conjoined modifiers* can be *combined with embedding*: Here multiple modifiers modify the same head, and one of them itself has a modifier, as in English [*totally bald*] *old man*. This results in a sequence of three modifiers. For instance, in response to the video clip depicted in Figure 7, the CTSL utterance in (4) conjoins BALD and SHIRT as modifiers of MAN, while RED is an embedded modifier of SHIRT.

Figure 7. Stimulus item: The man with the red shirt is laughing.

- (4) CTSL: MAN BALD SHIRT RED LAUGH / MAN SIT
 English: (The) bald man (with a) red shirt laugh(s), (the other) man sit(s)

It is important to note that in the three complex configurations, the multiple modifiers are simply concatenated. There appear to be no syntactic or morphological markers that determine what modifies what, for example that GLASSES modifies MAN and not BEARD in (3), but RED modifies SHIRT and not MAN in (4). Nevertheless, the proper target of modification can be ascertained on semantic and pragmatic grounds.

4.2. Results

In total, 134 instances of modification were observed in the responses of the twelve participants. Head-modifier word order was used in 72.06% of all instances. We take this to be the dominant order; the remaining 27.94% of instances used modifier-head order.

These numbers conceal a great deal of individual variation in use of modifiers. Figure 8 breaks down modifier use by individual subjects and cohorts. It shows that there is

substantial individual variation in the use of modification –not only in the number of responses that use modification (e.g. participants 5 and 11 vs. participants 2 and 3), but also in the preference for head-modifier order (e.g. participants 1 and 11 vs. participants 3, 9 and 12). However, there is generally more use of modifiers in CTSL-2 than CTSL-1 (there are too few CTSL-3 participants to make any judgment).¹¹

Figure 8. Word order preferences of each participant in their modification constructions ($N_{\text{total}}=134$; CTSL-1=1-4; CTSL-2=5-10; CTSL-3=11-12).

Across cohorts there was not a statistically significant difference in the use of dominant word order. CTSL-1 ($n=4$) signers produced modification constructions 17 times and their responses followed the dominant order 11 times (64.7%) of these instances. CTSL-2 ($n=6$) signers used modification 84 times and were more consistent with their 61 uses of dominant word order (72.6%). Signers of CTSL-3 ($n=2$) produced modification 33 times and used the dominant order in 26 of their constructions (78.8%); however this large percentage was entirely due to participant 11.

¹¹ Although there were only 19 video clips, some participants produced more than 19 instances of modification. This is either because they produced multiple modifications within a single response, or because it took them more than one response to try to convey the correct choice of picture to the addressee.

Turning to the varieties of modification, 70.1% were simple modification (SM, e.g. BOOK BIG), 11.2% were semantic embedding (SE, e.g. MAN SHIRT RED), 9% were conjoined modification (CM, e.g. MAN BALD BEARD), and 10% were both conjoined and embedded modification (CE, e.g. MAN BALD SHIRT RED), as shown in Figure 9.

Figure 9. Distribution of modification types and word order preferences for each type of modification ($N_{\text{total}}=134$).

Importantly, CTSL-1 rarely used complex modification structures, significantly less frequently than CTSL-2 ($\chi^2(1)=3.87, p=0.0492$, 95% CI [-0.077, 34.186]) and CTSL-3 ($\chi^2(1)=7.941, p=0.0048$, 95% CI [13.406, 56.904]) (Figure 10).

Figure 10. Use of complex modification constructions across cohorts ($N_{\text{total}}=40$ modifying constructions).

As illustrated in Figure 9, all constructions displayed a tendency to use the dominant word order. Overall, 68% of the simple modification constructions and 85% of all complex modification constructions followed the dominant head-modifier order. In other words, when signers used multiple modifiers to modify a single element, they followed the dominant word order more strictly than they did in simple modification strategies ($\chi^2(1) = 4.91, p = 0.0431, 95\% \text{ CI } [0.53, 29.75]$) (Figure 11). We see therefore that with increasing complexity, there is significant conventionalization and less variation in the use of word order.

Figure 11. Word order preferences in simple vs. complex modification constructions ($N_{\text{simple}}=94, N_{\text{complex}}=40$).

Negation

Our stimulus set was not designed to elicit responses with negation. However, we observed that some signers used negation as an additional strategy to differentiate between the members of the same semantic category. We therefore considered negation as a special instance of modification, focusing on how it is expressed through word order, and whether it shows any signs of conventionalization.

We identified a manual sign that was used to express negation and transcribed it as NOT. We also observed two non-manual signs, a slight head-tilt and “tsk” sound that frequently accompanied the manual sign. As the use of non-manuals is beyond the scope of this study, we coded only the use of the sign NOT in relation to the position of the element it negated (Figure 12).

Figure 12. The negation sign NOT as depicted by two different CTSL-2 signers: Palms initially facing the ground make an upward movement.

The responses fell into two patterns. The first is what we called *simple negation*, illustrated in (5). The video clip shows two women, one of whom is wearing a hat; the other woman rolls the ball.

- (5) CTSL: WOMAN HAT NOT / WOMAN BALL THROW-BALL
English: Woman without (the) hat, (that) woman throw(s) (the) ball.

Here, NOT negates HAT, following the order H-neg. Similarly, another video clip shows a woman eating an apple and a woman standing next to her. (6) is the response.

- (6) CTSL: WOMAN APPLE EAT / WOMAN STAND / APPLE GIVE NOT / WOMAN EAT APPLE
English: Woman eat(s) apple, woman (is) stand(ing), (she does) not give (the apple), she eat(s) (the) apple.

Here, NOT negates GIVE and it too follows the order H-Neg.

The second pattern for negation is somewhat more unexpected: a sort of constructional idiom that might be called X-NOT-Y. For instance, one video clip shows a man taking the small book, not the big one, eliciting the response in (7).

- (7) CTSL: BOOK SMALL BOOK SMALL TAKE SMALL.BOOK / BIG NOT SMALL
English: (The) small book, (the) small book, (the man) take(s the) small book, not (the) big (one but the) small (one)

Here, NOT negates BIG, hence this utterance follows the X-NOT-Y order. (8) is similar. The video clip shows two men sitting and playing cards, and a women standing up and sweeping.

- (8) CTSL: WOMAN BROOM SIT NOT STAND BROOM / WOMAN ONE
English: (The) woman sweep(s), (she is) not sit(ing), (she is) stand(ing and) sweep(ing), (there is only) one woman

Here, NOT negates SIT, and STAND immediately follows NOT, following the X-NOT-Y order.

Results of the negation study

The dominant order Head-Neg was observed in 89.47% of all uses of the negation word. All participants but two used exclusively the dominant word order in all of the negation constructions. The remaining two participants, both from CTSL-1, showed a preference for the non-dominant word order. The X-NOT-Y construction was used in 63.16% of all uses of negation. CTSL-1 used this construction less than CTSL-2 and signers in CTSL-2 used it less than CTSL-3. However, these differences were not significant ($p=0.16$ and $p=0.07$).

4.3. Discussion

Our results show, first, that the use of modifiers develops gradually from cohort to cohort (though CTSL-3 does not provide enough data to show this statistically). Although CTSL-1 signers did use modification fairly freely, they were less consistent with word order in simple modification, and they rarely used multiple modifier constructions.

Second, there is a dominant word order for modification in CTSL: head-modifier word order was used in 72.06% of all instances of modification. This contrasts with spoken Turkish, which consistently places the modifier before the modified element (in any unit that contains any number of modifiers). Hence we can confidently say that this regularity cannot be attributed to the surrounding spoken language.

What do we make of this regularity? The word order for modification is apparently not as conventionalized as, say, in Turkish: signers do not use it entirely consistently. Typically, either Head-Mod or Mod-Head order would be readily interpretable, given the pragmatics of the situation. However, consistently using one order rather than other cuts down choices, and therefore processing load, for both signer and addressee. So on functional grounds it pays to conventionalize a word order.

We also observed that many participants used multiple modifiers to modify a single element. Such constructions followed the dominant word order more strictly than did the

simple modification constructions. This suggests that greater semantic complexity calls more strongly for conventional order – even when the pragmatics are clear. For instance, MAN BEARD SHIRT RED can only be interpreted as ‘man with the beard and red shirt’ and not, say, ‘red bearded man with a shirt’ or the anomalous ‘red man with the bearded shirt’; and this would be the case regardless of the order of the elements. Yet the Head-Mod order appears to have (largely) conventionalized anyway, presumably in the interest of aiding processing.

However this issue is resolved, there is still a question as to exactly what is conventionalized. Is it a principle of syntactic structure? Or is it a simple correlation between linear order and semantic embedding, such as ‘expressions for semantic modifiers (preferably immediately) follow the expressions for what they modify? We take this question up in section 8.

Since negation is a type of modification, the findings of our second analysis complement our conclusions on conventionalization of word order for modification. Negation has an overwhelming tendency to follow what is negated. In addition, we have found the rather idiosyncratic X-NOT-Y construction, which appears in 63.16% of negation constructions, despite its apparent redundancy. However, it seems to serve as a rather simple way to emphasize and clarify the intended contrastive meaning.

Finally, we noticed in Figure 8 that participants 5 and 11 together used modification more than all the other participants combined. As it happens, they belong to the same family and live together (cf. ‘familylects’ in ABSL (Sandler et al., 2011)). This suggests that the preference to use modification is affected by signers’ frequency of interaction with other signers, parallel to the family-based variation in picture naming found in other emerging sign languages, cited in Study 1. Future studies should look at the use of word order across families and households to understand the extent of these interactions’ influence on regularities.

5. Study 3: Word order as an argument structure marker¹²

This study investigates the emergence of conventionalized uses of word order in CTSL to signal semantic roles (i.e., agent, patient, action) in one-argument, two-argument and three-argument events.

86% of spoken languages rely on a dominant word order for encoding syntactic and semantic arguments –with SOV as the most common word order, and SVO as the second most common– 48% and 41% respectively (Dryer (2005). Word order is also used to mark semantic roles in sign languages. Napoli and Sutton-Spence (2014) survey 42 sign languages, including village SLs, community SLs and established SLs, and find that SOV and SVO are the most prevalent tendencies. Other studies provide evidence for flexible word order in established sign languages (e.g., ASL: Fischer, 1975; Liddell, 1980; Padden, 2016; Wilbur, 1997); for Bolivian Sign Language: (LSB De Quadros, 1999), for British Sign Language: (Deuchar, 2013; Sutton-Spence & Woll, 1999); for Danish Sign Language: (Engberg-Pedersen, 1994).

In emerging sign languages, previous studies report a greater amount of variation. For example, Washabaugh (1986) reports absence of a consistent word order in a sign language that emerged in Providence Island, Colombia. In Nicaraguan Sign Language (NSL), Senghas et al. (1997) report variation in word order preferences across different age groups, without clear convergence on a particular order. In Israeli Sign Language, a tendency for consistent SOV is observed only in younger generations (Meir, 2010).

The present study supplements and builds on these previous findings, showing that in CTSL, degree of conventionalization of word order depends both on cohort and on the number of semantic arguments to be expressed.

¹² For a fuller discussion of argument structure of CTSL, see Ergin, Meir, et al. (2018).

5.1. Method

Participants. 14 deaf CTSL signers participated in this study: 5 CTSL-1 signers [Mean age =46.4, Range = 41-53, 2 females, 3 males], 6 CTSL-2 signers [Mean age =40.2, Range = 34-45, 4 females, 2 males], 3 CTSL-3 signers [Mean age =19.3, Range = 16-22, two females and one male]. The mean age and the age range correspond the ages of the participants when they were tested in 2013.

Stimuli. 30 short video clips, originally developed by Sandler et al. (2005). The clips involved twelve one-argument (*intransitive*) actions, twelve two-argument (*transitive*) actions, and six three-argument (*ditransitive*) actions. Seven of the one-argument clips involved a human agent (e.g., a girl falls) and five of them involved an inanimate theme (e.g. a bottle falls). In six of the two-argument clips, a human agent acts on an inanimate patient, such a man tapping a watermelon. These are *irreversible contexts*, in that a watermelon cannot tap a man. In the remaining six transitive clips, a human agent acts on a human patient, such as a man tapping a girl's shoulder. These are *reversible contexts*, in that a girl *can* tap a man's shoulder; these present more of a problem for linguistic expression. Finally, all of the three-argument clips involved a transfer of an inanimate theme from a human agent to a human goal (e.g., a man throws a ball to a girl) (see full list of stimuli in Appendix E).

Task. The task was the same as in Study 2. Deaf CTSL signers were paired up with an addressee who was either a deaf or proficient hearing CTSL signer (in the latter case, a sibling/spouse of a deaf signer). The signer viewed the clips on a computer screen and described them in CTSL to the addressee sitting in front of him/her, who then selected the corresponding picture from an array of three pictures for a comprehension check. Following a failed attempt, signers could produce up to two further attempts before they were asked to move on to the next clip.

Coding procedure. We determined the frequency of each word order that signers produced in one-, two- and three-argument responses. Both successful and unsuccessful attempts were included in the analysis; and we calculated success rates based on the success of an utterance produced in any of the three attempts. The rationale behind this procedure is that the unsuccessful responses were indeed responses, whether or not they are understood. Moreover, failure may not always be due to lack of specificity on the part of the signer, for instance if a CTSL-3 signer is addressing a CTSL-1 signer.

Two methodological points: First, the responses have been redacted so as to reflect only the word order of the signs for these three roles. For some fuller transcriptions of responses, see study 2. Second, we wish to remain agnostic as to whether CTSL has actual syntactic structure (Jackendoff and Wittenberg, 2014), and therefore whether the syntactic terms ‘subject’, ‘object’, and ‘verb’ are actually appropriate characterizations of CTSL structure. The evidence is equally consistent with defining word order in terms of semantic roles, so that ‘S’ is to be interpreted as Agent, ‘O’ as Patient, and ‘V’ as Action. We take this issue up in section 8.

5.2. Results

We break the analysis down by the number of arguments in the stimulus.

Results for one-argument structures:

213 responses ($n_{\text{CTSL-1}}=82$, $n_{\text{CTSL-2}}=90$, $n_{\text{CTSL-3}}=41$) were analyzed for word order in one-argument structures. Figure 13 shows the range of responses:

Figure 13. Word order preferences across cohorts in 1-argument structures. The Y-axis indicates the proportional frequency of responses involving the word orders listed on the X-axis. Blue, red and green bars represent CTSL-1, CTSL-2 and CTSL-3 signers, respectively.

The overwhelming majority of responses exhibit SV order (e.g., BOTTLE FALL), with 59% in CTSL-1, 94% in CTSL-2 and 100% in CTSL-3. Only a small proportion of the responses display VS order: 11% in CTSL-1 (specifically one CTSL-1 signer) and 1% in CTSL-2. The only other significant variant is V in CTSL-1 (21%), where many responses omitted the subject/Actor altogether. (The responses identified as ‘other’ could not be classified.)

The use of SV increases from CTSL-1 to CTSL-2 significantly ($\chi^2(1) = 14.09, p = 0.0002$, 95% CI [12.2, 40.7]); similarly for the increase between CTSL-2 and CTSL-3 ($\chi^2(1) = 4.15, p = 0.0415$, 95% CI [-0.35, 24.97]). In addition, the rate of successful choices by the addressee in response to SV increases across cohorts as follows: CTSL-1 = 82%, CTSL-2 = 94%, CTSL-3 = 95%, with a significant increase from CTSL-1 to CTSL-2 ($\chi^2(1) = 4.57, p = 0.0324$, 95% CI [0.8, 26]). The increasing tendency for SV combined with increasing success rates across cohorts suggests that CTSL signers have successfully converged on SV as the predominant word order in one-argument structures.

Results for two-argument structures:

247 responses were analyzed for word order in two-argument structures. It proved useful to develop separate analyses for irreversible contexts (human agent, inanimate patient)

and reversible contexts (human agent, human patient). Figure 14 shows the range of variants for irreversible contexts ($n_{\text{total}}=133$, $n_{\text{CTSL-1}}=55$, $n_{\text{CTSL-2}}=53$, $n_{\text{CTSL-3}}=25$). ‘V(o)’ denotes responses in which the object is incorporated into the verb as a classifier. ‘Other’ denotes responses which could not be clearly classified.

Figure 14. Word order preferences across cohorts in irreversible 2-argument structures (i.e., involving an animate agent and an inanimate patient). The Y-axis indicates the percentage of the responses involving the word orders on the X-axis.

There is an increasing tendency across cohorts toward verb-final order: CTSL-1 = 49%, CTSL-2 = 82%, CTSL-3 = 83%. CTSL-1 produces significantly fewer verb-final word orders as opposed to CTSL-2 ($\chi^2(1)=12.8$, $p=0.0003$, 95% CI [15.1, 48]) and CTSL-3 ($\chi^2(1)=8.1$, $p=0.0043$, 95% CI [11.2, 50.2]). The most frequent word order is SOV, with a significant increase from CTSL-1 to CTSL-2 ($\chi^2(1)=19.1$, $p<0.0001$, 95% CI [18.4, 48.8]) and from CTSL-2 to CTSL-3 ($\chi^2(1)=3.948$, $p=0.046$, 95% CI [-1.65, 46.85]). These patterns again indicate a change towards more uniformity in the language over time.

In CTSL-2 and CTSL-3, the second most frequent word order is SV(o); OSV is almost entirely absent (but see Figure 15 below for a different outcome). CTSL-1 displays a simpler profile: the most frequent orders are OV and V(o), omitting the subject but otherwise approximating the SOV and SV(o) of CTSL-2 and CTSL-3. Finally, the overall success rates for these irreversible scenarios are as follows: CTSL-1 = 60%, CTSL-2 = 85%, CTSL-3 = 80%, with a significant increase from CTSL-1 to CTSL-2 ($\chi^2(1)=8.3$, $p=0.0039$, 95% CI [8.1, 40]).

The reversible scenarios, in which the agent and patient can sensibly exchange roles, show quite a different distribution of responses. Figure 15 shows the responses for reversible scenarios ($n_{\text{total}}=114$, $n_{\text{CTSL-1}}=47$, $n_{\text{CTSL-2}}=46$, $n_{\text{CTSL-3}}=21$).

Figure 15. Word order preferences across cohorts in reversible 2-argument structures (i.e. involving an animate agent and an animate patient).

Word order preferences in reversible scenarios also display an increasing tendency for a verb-final pattern: CTSL-1 = 82%, CTSL-2 = 98%, CTSL-3 = 100%, again with a significantly lower use of verb-final word orders in CTSL-1, as opposed to CTSL-2 ($\chi^2(1)=6.5$, $p=0.0108$, 95% CI [3.6, 29.4]) and CTSL-3 ($\chi^2(1)=4.25$, $p=0.0392$, 95% CI [0.4, 31.3]).

Despite similar patterns, there are striking differences between reversible and irreversible scenarios. *First*, in reversible cases, i.e. when there are two human characters, there is a tendency for the order OSV, in which the patient precedes the agent, flouting the typologically widespread tendency to place agents first. For instance, describing a scenario of a woman pushing a girl, the OSV realization is GIRL WOMAN PUSH, rather than the expected SOV realization, WOMAN GIRL PUSH (cf. Hall, Mayberry, & Ferreira, 2013; Meir et al., 2017). The tendency toward using this configuration increases across cohorts. The opposition between OSV in reversible contexts and SOV in irreversible contexts is significant ($\chi^2(1)=0.51$, $p=0.0337$, 95% CI [0.36, 21.67]).

Second, a novel form, absent in CTSL-1, emerges in CTSL-2 in reversible scenarios; we will call it SV/SV. It splits the predicate in two, so that each sub-predicate has only a

single argument – a sort of serial verb construction. For instance given a scenario of a woman pushing a girl, the SV/SV description is WOMAN PUSH, GIRL FALL. This option is especially prominent in CTSL-2, but it is never used in CTSL-1 and is virtually absent in CTSL-3.

The overall success rates of the word orders in reversible contexts are as follows: CTSL-1 = 34%, CTSL-2 = 67%, CTSL-3 = 71%. In comparison with success rates in irreversible contexts, the success rates for word order preferences in reversible contexts are lower. This is presumably because pragmatics alone cannot disambiguate reversible contexts in isolation.

It is important to note that the word orders found in CTSL are not influenced by the surrounding spoken language. As a control, 23 Turkish speakers were confronted with the same task. Their 273 responses were analyzed to determine preferred word order in two-argument structures. Irrespective of the semantic category of the patient, there is a clear tendency for SOV in the entire task: 81% and 88% in responses involving animate and inanimate patients, respectively. The orders Turkish speakers produced conveyed the intended messages with a 100% success rate. Furthermore, the two-argument Turkish responses show no trace of CTSL's systematic variation between SOV and OSV in irreversible vs. reversible contexts. In addition, the word order preferences in this task are uniform, even though Turkish is a flexible word order language, in which word order can be influenced by information structure. This finding suggests that word order preferences across CTSL signers are clearly more variable than in a mature language.

Results for three-argument Structures:

150 responses ($n_{\text{CTSL-1}}=66$, $n_{\text{CTSL-2}}=53$, $n_{\text{CTSL-3}}=31$) were analyzed for word order preferences, as shown in Figure 16 ('I' in the word order options denotes the indirect object, i.e. the recipient). Note that the agent and the recipient in a giving scenario are reversible.

Figure 16. Word order preferences across cohorts for 3-argument structures. The Y-axis indicates the percentage of the responses involving the word orders on the X-axis.

As in two-argument structures, there is a strong tendency for a verb-final pattern:

CTSL-1 = 84%, CTSL-2 = 98%, CTSL-3 = 97%, with a significant increase from CTSL-1 to CTSL-2 ($\chi^2(1) = 6.5, p = 0.0109, 95\% \text{ CI } [3.3, 24.8]$). However, as the number of arguments increase, the potential word order combinations show a huge variety. Figure 16 basically shows a flat distribution with no clear convergence on a certain word order, apart from the relative strength of SIV(o) (CTSL-1 = 8%, CTSL-2 = 11%, CTSL-3 = 13%) and some tendency for SV/IV(o) (17%), SOIV (9%), and SOV/IOV (8%) in CSTL-2. Although there appears to be a peak for ISOV in CTSL-3 (23%), this order only comes from a single participant and cannot be generalized to the group. Finally, when compared to the success rates of word orders in two-argument structures, the overall success rates in three-argument structures are much lower in all three cohorts: CTSL-1 = 24%, CTSL-2 = 58%, CTSL-3 = 55%, with a significantly lower success rate in CTSL-1 as opposed to CTSL-2 ($\chi^2(1) = 14.1, p = 0.0002, 95\% \text{ CI } [16.3, 49]$) and CTSL-3 ($\chi^2(1) = 8.95, p = 0.0028, 95\% \text{ CI } [10.4, 49.2]$).

Again, as a control, 23 speakers of Turkish were tested in the same protocol. Their 115 responses conveyed the message with a 100% success rate and demonstrated a clear tendency for SIOV (68%) in three-argument structures. Along with the uniform Turkish word orders in response to two-argument events, a clear tendency for SIOV in three-argument

events provides a further reference point to evaluate the amount of variation in word order preferences in CTSL.

Given the relative unreliability of word order to describe two- and three-argument scenarios, CTSL signers use alternative devices to help clarify thematic roles. We have already seen one such device, namely the use of *successive one-argument constructions*, i.e. the SV/SV construction. This restricts each unit to one animate character per action, while the successive predicates identify who performs the action and who undergoes it.

Another strategy frequently used by CTSL-2 and CTSL-3 signers is *character assignment*. Signers may identify themselves, or someone else in the immediate physical environment, as one of the animate characters to clarify who is doing what to whom. An example for this strategy produced by a CTSL-2 signer is as shown in (9):

- (9) CTSL: MAN POINT-to-SELF BALL THROW / GIRL POINT-to-ADDRESSEE BALL CATCH
English: (There is a) man, (that's) me, (and) I throw a ball. (There is a) girl, (that's) you, (and) you catch (the) ball. (= 'A man throws a ball to a girl')

Finally, CTSL-2 and CTSL-3 signers very occasionally use spatially based grammatical devices that use abstract loci in the signing space to clarify semantic roles. An example for this strategy is as shown in (10) (see Ergin, Meir, et al., 2018 for further discussion):

- (10) CTSL: MAN POINT-to-LOC₁, GIRL POINT-to-LOC₂, BALL THROW (from LOC₁ to LOC₂)
English: (There is a) man (in) abstract-location-1, (there is a) girl (in) abstract-location-2, (a) ball goes from (the man's) location 1 to location 2. (= 'a man throws a ball to a girl')

5.3. Summary and discussion

The results shown here suggest that the use of word order for expressing argument structure is not (yet) fully conventionalized in CTSL. Single-argument SV structures are fairly stable across cohorts, though the general tendency of CTSL-1 to omit arguments limits

the degree of uniformity. In two-argument structures, CTSL-2 and -3 are tending toward conventionalization: SOV and SV(o) for irreversible contexts, and, to a lesser extent, OSV and (in CTSL-2) SV/SV in reversible contexts. Finally, expressions for three-argument structures are far more varied, suggesting that even the relatively sophisticated CTSL-3 signers do not have a canonical way to express them and are probably improvising.

An interesting side point concerns the codification of two-argument predicates. As mentioned, SV/SV emerges in the second cohort for describing an animate agent acting on an animate patient, in which the description is composed of two paratactic “clauses.” For instance, a girl pushing a man is described as GIRL PUSH, MAN GET-PUSHED. However, this configuration essentially disappears in the third cohort, supplanted by a different one. We conclude that the process of conventionalization of grammar is not unidirectional –it can lead to loss of patterns as well as addition.

Previous studies on word order preferences in emerging sign languages present evidence for patterns similar to those of CTSL. Senghas et al. (1997) report that the use of successive one-argument clauses (our SV/SV) appears in the second generation of NSL signers. The same basic strategy is present both in ISL and ABSL as well (Meir, 2010).

Emerging sign languages also display similar patterns in the development of spatial verb agreement. Like older CTSL signers, older signers of ISL hardly use spatial verb agreement; but it becomes more prevalent in the utterances of the younger signers. This is true as well for NSL: like CTSL-1 signers, the first cohort of NSL signers produce a spatially neutral version of argument structure, whereas Cohort 2 signers produce spatially marked forms (Senghas & Coppola, 2001). In contrast, ABSL signers do not use spatial verb agreement at all (Meir, 2010).

Although these emerging sign languages adopt similar patterns, they do not entirely follow the same developmental paths. For instance, Meir (2010) reports that ABSL signers

came to rely mainly on word order to encode argument structure within the span of one generation. In contrast, ISL signers did not develop a preferred word order until the third generation (Meir, 2010). And CTSL signers so far are not entirely consistent in their use of word order, aside from single-argument and irreversible two-argument patterns.

These differences among these emerging sign languages indicate that languages may differ in strategies for marking arguments, and in when they are conventionalized during the early stages of their existence. The rise and fall of SV/SV in CTSL also shows that even at this early stage, a seemingly established convention may be overtaken by another.

6. Study 4: Emergence of distinct verb classes¹³

Study 3 focused on how semantic roles in one-, two- and three-argument events are encoded in CTSL. In one-argument scenarios, a theme undergoes an action without external causation; in two- and three- argument scenarios, an agent acts on a patient. Study 4 investigates a semantically more complex configuration: the encoding of reciprocal and symmetrical events. Such events involve (at least) two human characters, each of whom performs an action on the other character and undergoes the same action performed by the other character. The overall question of Study 4 is whether CTSL signers can express this semantic complexity.

First we must make clear what we mean by reciprocal and symmetrical events. Their analysis goes back into the dim history of generative grammar (e.g. Gleitman, 1965 and McCawley (1971)), and is still not entirely settled (e.g. Gleitman, Gleitman, Miller, and Ostrin (1996) and Gleitman, 2017). Briefly, a *reciprocal* event involves an action such as punching, in which an agent acts on a patient; and each character performs this action on the other, either simultaneously or sequentially. Such a scenario would be described in English

¹³ For a fuller discussion of this study, see Ergin (2017).

by a sentence like *Bill and John punched each other*, consisting of the two sub-events of Bill punching John and John punching Bill.

In contrast, in a *symmetrical* event, the two characters identically and simultaneously participate in the event described by the predicate. For instance, the action of shaking hands is inherently symmetrical: Bill cannot shake hands all by himself, and if an event can be described as *Bill shook hands with John*, it can also be described as *John shook hands with Bill* or simply *John and Bill shook hands*. A symmetrical event is thus a single event, performed by the two actors cooperatively. The expression of symmetrical predicates in English is not entirely regular (e.g. **John and Bill resemble* is unexpectedly bad), but the semantic intuitions are clear.

Nicaraguan Sign Language gives distinct treatments to these two complex event types (Flaherty et al., 2013, 2014; Gleitman, 2017). In an ordinary reversible transitive context, i.e. a simple action of an animate agent acting on an animate patient, NSL signers produce two clauses, along the lines of the SV/SV configuration in study 3 (e.g. Person₁ PUNCH / Person₂ GET-PUNCHED). In a reciprocal version of the same event, they produce *four* clauses (e.g. Person₁ Person₂ PUNCH₁, PUNCH₂, GET-PUNCHED₁, GET-PUNCHED₂, where the subscripts denote locations in signing space). However, for symmetrical events they produce a single clause (e.g. Person₁ Person₂ MEET). Furthermore, in symmetrical events, both NSL signers and Nicaraguan homesigners use mirrored articulators (to be explained in the coding procedure and Results section), but do not use them in transitive and reciprocal events. Building upon the research on NSL, we report how CTSL handles the semantic complexity of reciprocal and symmetrical events.

6.1. Methods

Participants. 12 deaf CTSL signers, grouped into the three cohorts, participated ($M_{\text{age}}=40.3$, age range: 18-55; 8 Females, 4 males; 4 CTSL-1 signers, 6 CTSL-2 signers, 2

CTSL-3 signers). The mean age and the age range correspond the ages of the participants when they were tested in August 2015.

Stimuli. We devised a controlled elicitation task in which deaf signers viewed 54 short clips (see Appendix F). All of the participants viewed the actions in the same randomized order.

30 of the 54 clips consisted of 10 actions involving two human characters. Each action was displayed in three different versions, illustrated in Figure 17: (a) an intransitive action with two separate agents (e.g. both waving to the camera); (b) a simple transitive action with an animate patient (e.g. one woman waves to the other); and (c) a reciprocal version of the same action (e.g. the two women waving to each other).

Figure 17. Three versions of *wave* that were used in the stimulus set

The rationale behind this design was to pull apart the expression of reciprocal actions, such as Figure 17c, from the expression of the same actions in the two other scenarios, which served as controls.

In addition to these 30 clips, 10 clips depicted symmetrical actions (e.g. shaking hands, slow dance, arm-wrestling, high-five), as illustrated in Figure 18. The remaining 14 video clips were fillers involving solo performers performing one of these actions in an intransitive (e.g. a single man punches toward the camera), or a transitive construction with an inanimate patient (e.g. a single man punches a wall).

Figure 18. Examples for the symmetrical events from the stimulus set.

Task. The task was the same as in Study 2 and 3.

Coding Procedure. All of the responses except for those not involving an action (e.g., SO, S, O) were coded for the following three strategies: (a) *temporal sequencing* of two subevents; (b) *body segmentation*, representing the two characters by using different sides of the body; (c) representing the two characters by *mirroring* the actions of the two hands.

6.2. Results

There were a total of 678 responses (180 intransitives, 171 transitives, 190 reciprocal, 137 symmetrical) from the three cohorts ($n_{\text{CTSL-1}}=225$, $n_{\text{CTSL-2}}=331$, $n_{\text{CTSL-3}}=122$). These responses were analyzed for the three candidate structural devices. We take these up in turn.

First, in *temporal sequencing*, signers distribute information temporally across an utterance by sequentially signing each character's role in the action. For instance, responding to a video with a simple transitive event of one man punching another, the two characters are taking part simultaneously. However, CTSL signers often produce utterances such as MAN PUNCH / MAN OTHER FALL-BACK, breaking the transitive event into sub-events and signing them sequentially, as shown in Figure 19. (This is the SV/SV pattern of Study 3.)

a. 'punch' performed by the agent

b. 'fall.back' undergone by the patient

Figure 19. Temporal sequencing for the reversible transitive version of 'punch'.

Figure 20 shows the extent to which signers of each cohort used temporal sequencing in expressing intransitive plural actions (Figure 17a), simple transitive actions (Figure 17b), reciprocal actions (Figure 17c), and symmetrical actions (Figure 18).

Figure 20. Proportion of temporal sequencing of actions across cohorts. Y axis stands for the percentage of responses involving temporal sequencing.

The first thing to notice is that temporal sequencing is virtually absent in symmetrical events. Second, temporal sequencing is also nearly absent in CTSL-1, in all contexts. It is significantly greater in CTSL-2 for both plural intransitives (e.g. WOMAN WAVE /WOMAN OTHER WAVE) ($\chi^2(1) = 15.091, p = 0.0001, 95\% \text{ CI } [14.1, 35.7]$), and for simple transitives (i.e., the SV/SV pattern) ($\chi^2(1) = 14.48, p = 0.0001, 95\% \text{ CI } [14.9, 41.1]$). The increase in reciprocals is

borderline ($\chi^2(1) = 3.3, p = 0.07, 95\% \text{ CI} [-1.05, 23.17]$). The increase from CTSL-2 to CTSL-3 is not statistically significant, probably because of the small number of CTSL-3 signers.

In the second special strategy, *body segmentation*, signers allocate one side of the body for one of the characters and the other side of the body for the other character. Figure 21 illustrates a reciprocal punch performed by a CTSL-2 signer. Right and left hands represent the two characters involved in the event: PERSON₁ and PERSON₂, respectively. The right hand, the right side of the body, and the right side of the signing space are allocated for PERSON₁, and the left hand, the left side of the body, and the left side of the signing space are allocated for PERSON₂. PERSON₁ punches towards the left, signaling that s/he is punching PERSON₂; and PERSON₂ punches towards the right, signaling that s/he is punching PERSON₁.

Figure 21. Body segmentation for the reciprocal version of ‘punch’.

Figure 22 shows the use of body segmentation across event types and cohorts.

Figure 21. Overall proportion of body segmentation across cohorts. Y axis stands for the percentage of responses involving body segmentation.

Body segmentation is strong from the beginning for reciprocal and symmetrical actions. It increases significantly from CTSL-1 to CTSL-2 for plural intransitives ($\chi^2(1) = 7.95$, $p = 0.0048$, 95% CI [7.2, 35.9]), and its increase is borderline for reciprocals ($\chi^2(1) = 3.52$, $p = 0.06$, 95% CI [-0.6, 29.97]). However, it is rare in simple transitive contexts, in all cohorts.

The third special strategy is *mirroring*: signing with both hands in a mirror-image configuration in which both hands perform the same action on each other. Figure 23 shows a CTSL-2 signer using both hands in a mirror-image configuration while signing symmetrical toasting.

Figure 23. Mirror-image configuration in ‘toasting’. Signer’s fists represent the cups the two characters in the video clips hold and toast with.

Figure 24 shows the use of mirrored articulators across cohorts.

Figure 24. Overall proportion of mirrored articulators across cohorts. The Y axis records the percentage of responses involving mirrored articulators.

Mirrored articulators appear almost exclusively in reciprocal and symmetrical actions, in other words, for events involving symmetry. Their use is already strong in CTSL-1, and it increases significantly from CTSL-1 to CTSL-2 ($\chi^2(1) = 7.35, p = 0.0067$, 95% CI [6.2, 36.5]) in reciprocal actions.

The reason for the use of mirrored articulators only in reciprocal and symmetrical actions is that these events involve symmetry, but intransitive and transitive actions do not. It is the mirror-image configuration that marks the identical participation of the characters in reciprocal and symmetrical events.

6.3. Discussion

Briefly, our results indicate that:

- Reciprocal and symmetrical actions use body segmentation and mirroring, which are rare or even absent in simple transitive and plural intransitive actions.
- Reciprocal and symmetrical actions as well as plural intransitive actions use body segmentation far more than do transitive actions.
- So far reciprocals and symmetrics are comparable. However, they diverge in their use of temporal sequencing: this appears in reciprocal events but is virtually absent in symmetrical events.

In summary, each type of action has its own combination of components to encode symmetry and non-symmetry, and these components become more conventionalized across cohorts (most reliably, again, from CTSL-1 to CTSL-2).

We also notice that body segmentation and mirroring are already strong tendencies in CTSL-1, while temporal sequencing takes until CTSL-2 to achieve some frequency. We conjecture that body segmentation, mirroring, and double perspective make use of the

iconicity of the body, whereas temporal sequencing is somewhat more abstract and takes time to invent as a structural marker.

We conclude that there is pressure from semantics to try to express symmetrical and reciprocal actions, while leaving open exactly how they are to be expressed. From the point of view of developed spoken languages, this should not be a surprise. But it reinforces the point that the development of sign languages from scratch follows principles familiar from spoken languages.

More broadly speaking, the rapid cultural development of linguistic expressions that distinguish reciprocal and symmetrical actions from transitive actions and from each other suggests that language learners already possess a sensitivity to the semantics of these distinctions, and are poised to express them as soon as someone invents a way to do it.

7. General discussion

The four studies discussed here give us a partial snapshot of one stage in the development of a new language. They raise at least as many questions as they answer. This section and the next take up some of the issues.

Conventionalization

As discussed in the introduction, we regard conventionalization of an item as the degree to which it is used uniformly throughout the language community. We have found that the items elicited in this study present radically different degrees of conventionalization. Among signs for everyday objects and food items, some signs such as those for ‘spoon’ and ‘match’ are used by everyone, though not with identical phonological/phonetic detail. This leads us to believe that these signs are part of CTSL signers’ conventional vocabulary. In contrast, some objects and food items such as ‘gas tank’ and ‘walnut’ seem to have no conventional sign, and signers appear to be improvising descriptions on the spot.

However, even when there is no conventional sign, the various descriptions often contain widely shared components. What we do not know is whether the shared components are partially conventionalized (i.e. many signers store ...SWITCH... as a partial lexical entry for ‘gas tank’), or whether the shared components are simply a consequence of the affordances of the objects themselves (e.g. the switch is a readily observed cue for spontaneously identifying the gas tank). It is difficult to know how to decide between these possibilities.

One way to help decide would be to study within-participant variation. When a signer uses a particular sign consistently on different occasions, we are inclined to think this sign is in the individual’s lexicon. On the other hand, if the signer produces different signs for the same thing on different occasions, it could be either that his/her lexicon lists multiple signs, or that it contains *no* appropriate signs and the signer is improvising. As mentioned in Study 1, 8 of the picture-naming items did reappear in the elicitations of event structure in Study 2.¹⁴ There we found that signers still displayed a great deal of variation, though not as much as in picture naming. This suggests that the picture-naming contexts are eliciting a certain amount of extra on-the-fly description, but that there is still a considerable way to go before these items conventionalize fully.

Varying degrees of conventionalization are found not only in signs for objects, but also in phrasal constructions. For example, two of the CTSL-1 signers made fairly consistent use of Head-Modifier and Head-Negation, and this order becomes increasingly predominant across cohorts. The order Head-Negation is completely uniform in CTSL-2 and CTSL-3; the X-NOT-Y construction increases in use through the cohorts.

Among the argument structure patterns, SV order for one-argument events is dominant already in CTSL-1. However, beyond this, CTSL-1 shows little sign of

¹⁴ Other portions of our CTSL corpus also contain relevant data, whose analysis has to be put off for future work.

conventionalization of argument order. On the other hand, all the two-argument patterns and the complex modification construction become evident in CTSL-2. In particular, the SV/SV construction is highly conventionalized in CTSL-2 as a way of describing reversible transitive events, though it is not taken up in CTSL-3. Finally, in describing reciprocal and symmetrical events, body segmentation and mirrored articulators are prominent already in CTSL-1, while temporal sequencing is more gradual in its onset.

These varied courses of development may be a matter of chance, or it may be that the later-developing patterns are more abstract or more complex. For instance, complexity arguably plays a role in the treatment of three-argument scenarios, which so far show no sign of conventionalization. None of the cohorts appears to have a consistent way to describe such events –they are as disparate here as in describing the gas tank, suggesting again that they are improvising on the spot, even in cohort 3.

Turning briefly to conventionalization in morphology: As suggested in Study 1, compounding is common, whether in conventionalized compounds or with signs with multiple variants, such as those in (11).

- (11) a. **fork**: fork handshape, spearing food on fork + EAT
(one of 5 variants in Study 1)
- b. **teapot**: TEA + ONE-ON-ANOTHER
(one of 9 variants in Study 1)
- c. **plate**: CIRCshape (tracing a circular shape in the signing space) + FLATshape
(both hands combined and facing upward)
(One of 10 variants in Study 1)
- d. **onion**: CIRCshape (one hand facing upward) + CHOP
(one of 11 variants in Study 1)

In established sign languages, the counterpart of affixal morphology is the modulation of a verb's sign to encode factors such as the approximate shape of an object in motion, spatial trajectory, repetition, distributivity, and so forth (Klima & Bellugi, 1979). We have observed such modulations in CTSL, as well. First, among the word order possibilities in Study 3 were combinations with V(o). This coding stands for the execution of a motion

predicate with a classifier handshape that reflects the character of the Patient; this modulation takes the place of an independent expression of the Patient, and might therefore be considered parallel to such phenomena as object clitics and/or noun incorporation. Second, Study 4 examined the use of temporal sequencing, body segmentation, and mirroring to express reciprocity and symmetry. These are all expressed by modulation of the predicate. Participants even apply these modulations when they improvise predicates for scenarios that lack a conventionalized sign, such as sword-fighting, tug-of-war, and spinning while holding hands (though CTSL-1 signers are somewhat at a loss with such cases). Thus these morphological elements appear to be productive.

With the degree of variation found among the members of the language community, the question arises as to how they manage to understand one another. If individual signers are consistent in their usage, but differ from one to the next in their usage, it would be possible for a signer to internalize but not use other signers' forms (i.e. "I say it *this* way, but so-and-so says it *that* way"), particularly because the community is so small. Alternatively, signers could be interpreting other signers on the fly by loosening their own rules (i.e. "That's not the way I would say it, but I guess she means *this*"). Of course, ordinary conversation offers a great deal of contextual support that is virtually absent in our elicitation protocols, and this surely is a strong aid in mutual comprehension.

Acquisition

As with many other emerging languages such as Nicaraguan Sign Language and Al-Sayyid Bedouin Sign Language, as well as for home signs, the CTSL community has developed as a linguistic system that did not exist before. In the present case, CTSL-1 is not a terribly elaborate system, at least compared to developed languages such as English, Turkish, and established sign languages such as ASL and BSL. But still, it functions with some degree of reliability in the language community. How did this system, such as it is, come about?

Our construal of the situation is that the so-called language-ready brain of humans is hungry for linguistic input. Just as the visual areas of the brain cannot help parsing emojis and the man in the moon as faces, the language areas cannot help interpreting any input with appropriate temporal dynamics and apparent communicative intent (whatever the relevant cues for that may be) as linguistic. For a deaf child in a nonsigning environment, the best candidates for such input are co-speech gesture and facial expressions. However, since such input actually does not have much linguistic structure, the best the child can do is to improvise a home sign.

But suppose the child also has access to other home signers. Their input to each other is a bit more language-like, making it possible to bootstrap into a somewhat more expressive system such as CTSL-1.¹⁵ The deaf younger siblings of these individuals in turn would have CTSL-1 as input. *Their* language areas would take this input to be more systematic than did the producers of the input – the CTSL-1 signers – and this would have led to further structured improvisation among the members of the second cohort, resulting in CTSL-2. In a way, this parallels the situation studied by Singleton and Newport (2004): the hearing parents of a deaf child signed to him in rather fragmentary ASL, yet the child developed a more articulated system, closer to ASL itself. In the case of CTSL, of course the learners also had input from each other, which apparently amplified the development of new features. At the same time, the variation among signers suggests that they have not all developed quite the same system in response to the input.

To sum up, we have found that conventionalization in CTSL is fragmented. There is no sharp line where we can say “now it’s conventionalized.” The studies presented here give

¹⁵ We actually do not know how much of contemporary CTSL-1 was present at that early stage, and how much of the system was added later by virtue of having CTSL-2 signers in the context. Relying on the “apparent time” hypothesis of Labov (1972, 1994, 2011), we treat today’s CTSL-1 as a reasonable approximation of the earlier stages of the language.

us many new data points for comparison with other emerging sign languages and with sign languages in general.

8. The status of syntax in CTSL

What is the grammar of a CTSL signer like? In addressing this question, we wish to resist what Jackendoff (2002) terms the “syntactocentric” conception of language – the widespread preconception that all systematicity in a language is a consequence of syntactic generativity. Rather, we conjecture that much if not all of CTSL grammar can be described in terms of correlations (often probabilistic) between semantic roles and superficial linear word order. Jackendoff and Wittenberg (2014, 2016) call such a language a *linear grammar*, and offer several candidates for this status. Jackendoff (2002, chapter 8) suggests that symptoms of linear grammar are to be found in more established languages as well, in phenomena such as compounding and the grammar of adjuncts. Jackendoff (2002) and Jackendoff and Wittenberg (2016) therefore propose that linear grammar is a stepping-stone to phrasal (syntactic) grammar, and that phrasal grammar constitutes an elaboration of linear grammar, not a complete replacement.¹⁶

To elaborate this point further: A traditional syntactically-based approach to CTSL would map a (semantic) Agent into an NP with the grammatical role Subject, map a Patient into an NP with the grammatical role Object, and map the Action into a verb; it would then stipulate a linear order in terms of grammatical roles, say Subject-Object-Verb (SOV). However, at least for the data presented here, a description of CTSL has no need to appeal to syntactic categories such as N, V, and NP, nor to grammatical roles such as Subject and Object. It is possible to simply map the semantic roles directly into linear order: semantic

¹⁶ Our linear grammar is fairly close to the notion of ‘protolanguage’ proposed by Bickerton (1990). Jackendoff and Wittenberg (2014) propose a hierarchy of grammars, of increasing complexity (and quite distinct from the familiar Chomsky hierarchy). Linear grammar/protolanguage falls somewhere in the middle of the hierarchy, while more established languages are at or near the top.

Agent precedes semantic Patient, which in turn precedes Action. Thus, rather than speaking of word order in the language as, say, SOV (subject-object-verb), we can characterize it as Agent-Patient-Action (see Ergin, 2017; Ergin et al., 2018).

In particular, the elicited utterances show very little in the way of what might be called syntactic fabric. The responses in Study 3 were redacted in order to concentrate on the ordering of Actor, Patient, and Action, so the real character of the language was to some degree obscured. However, raw examples from Studies 1 and 2, such as those in (12), better reveal the fragmentary nature of many of the utterances. The English translations supply considerable connective tissue in parentheses, not present in the CTSL utterances.

- (12) a. CTSL: SWITCH TALL WIDE
English: (It has a) switch, (it is) tall (and) wide ('gas tank')
- b. CTSL: BOOK SMALL BOOK SMALL TAKE SMALL.BOOK / BIG NOT SMALL
English: (The) small book, (the) small book, (the man) take(s) (the) small book, not (the) big (one but the) small (one).
- c. CTSL: WOMAN BROOM SIT NOT STAND BROOM / WOMAN ONE
English: (The) woman sweep(s), (she is) not sit(ing), (she is) stand(ing)(and) sweep(ing), (there is only) one woman

Similarly, (13) presents two utterances of a signer from the third and "most advanced" cohort, in the course of a spontaneous narration.

- (13) a. CTSL: POINT (to self) – SIT.ON.DONKEY – TIE – FALL – NOT
English: I sat on (the) donkey. (My grandfather) tie(d me) (so I would) not fall.
- b. CTSL: SHOE – SMALL – STONE – GO.INSIDE – GET.STUCK – WOUND – BLEED – BLEED – BLEED
English: (A) small stone went inside (my) shoe. (It got) stuck (there). (I got) wounded(ed). (It was) bleed(ing) a lot

These expressions are typical. In particular, we find no counterparts in CTSL of syntactic phenomena such as passives, cleft constructions, functional categories, agreement, case, complement clauses, relative clauses, or long-distance dependencies. Where a more complex grammar would use subordinate clauses, CSTL signers invariably use parataxis. For instance, here again is an example from Study 2. The natural English translation would be

The man (who is) wearing the red shirt throws the ball; CTSL dispenses with any mark of subordination.¹⁷

- (14) CTSL: MAN SHIRT RED//MAN THROW-BALL
English: (The) man (with the) red shirt, (that) man throw(s) (the) ball.

In fact, there is no purely syntactic evidence even for a category of nouns. Such evidence would require there to be, in addition to words for objects, words for events like English *party*, *nap*, and *event* that behave syntactically like nouns in requiring a determiner, permitting adjectival modification, being case-marked, and/or hosting relative clauses. There do not appear to be such words in CTSL, so the semantic categories of Object and Person appear to be sufficient for all grammatical description (see Ergin & Brentari, 2017); for similar arguments concerning the spoken language Riau Indonesian (see Gil, 2009). Indeed, while arguing for a noun-verb distinction in established and emerging sign languages, Abner et al. (2019) concede that the distinction in question can equally be characterized as Object vs. Action; i.e., as a semantic rather than syntactic distinction. We advocate for similar substitutions in the analyses presented here.

The most promising evidence for syntactic structure comes from the examples with different interpretations of multiple modifiers, for instance MAN SHIRT GLASSES vs. MAN SHIRT RED. The former is clearly interpreted as ‘man; [wearing shirt]; [wearing glasses]’, with conjoined modifiers. The latter is understood as ‘man; [wearing [shirt; red]]’, in which the second modifier modifies the first. This difference could be taken as evidence for different syntactic structures, along the lines of (15).

¹⁷ We acknowledge the possibility that subordination is marked by non-manuals, which we did not analyze here.

However, it is also possible to map directly from semantic structure to simple linear order. The principle is that a semantic modifier must follow what it modifies, as closely as possible. This accounts directly for MAN SHIRT RED, in that SHIRT immediately follows MAN and RED immediately follows SHIRT. In the case of MAN SHIRT GLASSES, it is impossible to position both modifiers immediately after the head, so the grammar settles for the next best solution (perhaps in Optimality Theory fashion), placing GLASSES directly after SHIRT. The present data give us no way to tell whether syntax is necessary for such cases in general, or whether the more direct mapping from semantics to linear order can be sustained (possibly supplemented by prosodic constituency). In short, we conclude that, possibly aside from these examples of modification, CTSL offers no evidence for traditional syntactic structure.¹⁸

This analysis must not be construed as demeaning languages with linear grammar, treating them as somehow “less than language” just because they lack (most of) the trappings of conventional syntax. It is only if one believes that syntax is the *sine qua non* of language that one can arrive at this position. In our view, languages with linear grammar are still productive mappings between sound and meaning, functioning for communication in a community.

Of course, if CTSL lacks syntactic structure, the question arises of what further developments would lead learners to begin incorporating syntax into their grammars. On the other hand, if CTSL *does* have syntactic structure, the same question arises: what evidence did learners use, and in what stage of development of the language. We leave the issue open.

¹⁸ Hunsicker and Goldin-Meadow (2012) argue that their homesigner David produced syntactic NP constituents consisting of a noun and a demonstrative. We believe that their analysis can be recast in semantic terms, as we have proposed for head-modifier sequences here; however this is not the place to undertake such a reanalysis. An alternative possibility is that it is not necessary for a grammar to be exclusively linear or exclusively syntactic. Just as a syntactic language may harbor pockets of linear grammar, linear languages may incorporate syntactified fragments. On this account, the CTSL syntactic structures in (15) and David’s NPs may constitute such fragments, leaving the rest of their grammars linear.

9. Concluding remarks

We conclude this paper with a number of cautions and comments. First, the community of CTSL signers is quite small, so the data we have been able to collect is limited. Second, the responses from elicitations are stochastic (or probabilistic), that is, practically all the phenomena we examine are only partially conventionalized –though there is less variation among younger cohorts. This situation contrasts with results on some of the same elicitation experiments conducted with native Turkish speakers, who were far more uniform in their responses (see Study 3). Third, in each study, we have for the most part recorded only a single elicitation from each individual for a certain stimulus item. We therefore can only look at between-individual variation. It would be of great interest to see how consistent each particular individual is in the task, that is, the scope of within-individual variation. The little evidence we have for such variation suggests that it too is considerable. Finally, we have investigated only a small number of phenomena, so we have probably raised more questions than we have answered. Much remains for future work¹⁹.

¹⁹ The elicitation experiments described here are not our only source of CTSL data. Our corpus also contains recordings of spontaneous conversation and story telling. Some of this material has been coded; much has not. So even the data we have may offer insight into a variety of further questions.

Appendix A: Participants

	Participant	Gender	Age ²⁰	Village	Schooling	Addressee
CTSL-1	1. Durana	Female	53	1	No	Her cousin, deaf native CTSL signer, age: 43, not schooled
	2. Hamza	Male	49	1	No	His son, hearing, native CTSL signer, age: 17, from Village 1, schooled
	3. Ali	Male	46	1	No	His sister, deaf native CTSL signer, age: 41, not schooled
	4. Durana	Female	43	Originally from Village 1 but lives in Village 3	No	Her sister, hearing, native CTSL signer, age: 39, from Village 1, schooled (5 years)
	5. Mehmet	Male	41	2	No	His brother, deaf, native CTSL signer, age: 38, from Village 2, not schooled
CTSL-2	6. Serife	Female	45	1	No	Her niece, deaf native CTSL signer, age: 15, from Village 1, schooled (for 4 years)
	7. Fatma (Aunt)	Female	43	1	No	Her niece, hearing, native CTSL signer, age: 15, from Village 1, schooled (for 4 years)
	8. Fatma	Female	43	1	No	Her cousin, deaf native CTSL signer, age: 45, not schooled
	9. Bayram	Male	38	2 (Married with Ulku from Village 1)	No	Neighbor, deaf native CSTL signer, age: 22, schooled
	10. Zafer	Male	38	1	No	His nephew, hearing, native CTSL signer, age: 17, from Village 1, schooled
	11. Ulku	Female	34	Originally from Village 1 but lives in Village 2 – Married with Bayram from Village 2	No	Her sister, hearing, native CTSL signer, age: 39, from Village 1, schooled (5 years)
CTSL-3	12. Mustafa	Male	22	2 (He went to school with Sengul)	Yes	With a deaf native CTSL signer from Village 2, age: 38, not schooled
	13. Sengul	Female	20	1	Yes	Her aunt, deaf native CTSL signer, age: 43, from Village 1, not schooled.
	14. Ilknur	Female	16	1	For 4 years between ages 7-11	Her father, deaf individual from CTSL-2, age: 37, from Village 1, not schooled

CTSL-1, n=5, 41-53 years old; CTSL-2, n=6, 34-45 years old; CTSL-2, n=3, 16-22

²⁰ The ages of the participants are those in August 2013 when they were first tested.

Appendix B: Stimuli used in Study 1

Common Objects:

Glass

Fork

Spoon

Teapot

Cooking Pot

Glasses

Car

Watch

TV

Matches

Cologne

Plate

Flour Sifter

Soap

Gas Tank

Fruits/Vegetables:

Potatoes

Squash

Onions

Garlic

Peppers

Cucumber

Tomatoes

Eggs

Cheese

Figs

Sugar

Salt

Plums

Apple

Walnuts

Potato Soup

Olives

Quince

Melon

Watermelon

Grapes

Tea

Sunflower Oil

The contexts and target items used for contextual analysis in Study 1:

- 1) Man puts the **teapot** into the box
- 2) Woman drops the **glasses**
- 3) Woman puts the **glass** on the table
- 4) **TV** falls
- 5) Man eats from his **plate**, woman eats from her plate
- 6) Man puts the **onion** into the bag
- 7) Woman cuts the **watermelon**
- 8) Woman eats **apple** and writes

Appendix C: Stimuli used in Study 2

Scene	Modification by:
1. The man takes the smaller book.	Size of object
2. The woman takes the bigger bottle from the table	Size of object
3. The woman takes the lemon from the chair.	Location of object
4. The woman with the hat rolls the ball.	Character
5. The man with a red shirt is throwing the ball.	Character
6. The woman without the hat rolls the ball.	Character
7. A man is dancing and the other man is video recording.	Character
8. A woman is sweeping and the other is walking around.	Character
9. The man takes the bottle from woman.	Character
10. A woman is sitting and eating apple, the other one is standing next to her.	Character
11. The man puts the hat on woman's head	Character
12. Man and woman are sitting. The woman is writing and the man is looking at what she's writing.	Character
13. The man with the red shirt is laughing.	Character
14. The woman tickles man's foot.	Character
15. The woman on the right is pushing the man in the middle.	Character
16. Two men are playing cards and a woman is sweeping around them.	Character
17. The woman on the left gives the hat to the man in the middle.	Character
18. The man on the left gives a hat to the man on the right.	Character
19. Two women are throwing a ball to each other and a man in between is watching them.	Character

Appendix D: Task used in Study 3

Video clip: The woman with the hat rolls the ball.

The pictures used for comprehension check:

Appendix E: Stimuli used in Study 3

Elicitation Sentences

1. Bag falls	1. One-argument
2. Ball rolls	2. One-argument
3. Ball bounces	3. One-argument
4. Bottle falls	4. One-argument
5. Water pours	5. One-argument
6. Girl falls	6. One-argument
7. Girl cries	7. One-argument
8. Man sleeps	8. One-argument
9. Man stands up	9. One-argument
10. Woman runs	10. One-argument
11. Woman walks	11. One-argument
12. Woman writes on the refrigerator	12. One-argument
13. A girl runs in a circular direction	13. One-argument
14. A woman puts a box on the table	14. Irreversible, two-argument
15. A girl pulls the shopping cart	15. Irreversible, two-argument
16. A woman rolls the ball	16. Irreversible, two-argument
17. A man taps the watermelon	17. Irreversible, two-argument
18. A girl tears the paper	18. Irreversible, two-argument
19. A man washes the plate	19. Irreversible, two-argument
20. A man places a book into the bookstore	20. Irreversible, two-argument
21. A girl combs the woman's hair	21. Reversible, two-argument
22. A woman looks at the man	22. Reversible, two-argument
23. A girl pulls a man's arm	23. Reversible, two-argument
24. A woman pushes the girl	24. Reversible, two-argument
25. A man taps girl's arm	25. Reversible, two-argument
26. A woman gives a shirt to the man	26. Reversible, three-argument
27. A woman takes scissors from a girl	27. Reversible, three-argument
28. A man shows a picture to a woman	28. Reversible, three-argument
29. A man throws a ball to the girl	29. Reversible, three-argument
30. A girl feeds woman	30. Reversible, three-argument

Appendix F: Stimuli Set in Study 4

Set 1: *wave*

Two women (standing side by side) wave hands to the camera	Intransitive-PL
A woman waves hand to the other woman	Reversible transitive
Two women (facing each other) wave hand at each other	Reciprocal

Set 2: *kiss*

Two women (standing side by side) kiss towards the camera	Intransitive-PL
A woman kisses the other woman	Reversible transitive
Two women kiss each other	Reciprocal

Set 3: *punch*

Two men (standing side by side) punch towards the camera	Intransitive-PL
A man punches another man	Reversible transitive
Two men punch each other	Reciprocal

Set 4: *hug*

Two women (standing side by side) hug pillows	Intransitive-PL
A man hugs a woman	Reversible transitive
Two women hug each other	Reciprocal

Set 5: *tap*

Two men (standing side by side) tap the table	Intransitive-PL
A woman taps on the man's shoulder	Reversible transitive
A woman and a man tap each other's shoulders	Reciprocal

Set 6: *sword-fight*

A woman and a man (side by side) play sword-fighting towards the camera	Intransitive-PL
A woman attacks a man with a sword	Reversible transitive
A man and a woman sword-fight with each other	Reciprocal

Set 7: *throw ball*

A woman and a man throw ball to the camera	Intransitive-PL
A woman throws a ball to a man	Reversible transitive
A man and a woman throw balls to each other	Reciprocal

Set 8: *feed*

A man and a women (facing camera) eat yogurt	Intransitive-PL
A woman feeds a man with yogurt	Reversible transitive
A man and a woman feed each other with yogurt	Reciprocal

Set 9: *dance*

Two men (facing camera) dance	Intransitive-PL
N/A ²¹	Reversible transitive
Two man (facing each other) folk dance	Reciprocal

²¹ Reversible transitive version of 'Turkish folk dance' in set 9 is a logical impossibility, as is the plural intransitive version of 'collide' in set 10. These items were replaced with an additional reversible transitive and a plural intransitive event in order for each event type to be equally represented in the task.

Set 10: collide a

N/A	Intransitive-PL
A man collides with a woman	Reversible transitive
Two men collide with each other	Reciprocal

Substitutions.

A ball hits a man (substitute for set 9)	Reversible transitive
Two man (facing camera) raise their coffee cups (substitute for set 10)	Intransitive-PL

Symmetrical items.

A man and a woman walk arm in arm	Symmetrical
A man and a woman hold hands and spin around each other	Symmetrical
Four people play tug-of-war	Symmetrical
A woman and a man high-five	Symmetrical
A man and a woman slow dance	Symmetrical
Two men shake hands	Symmetrical
A woman and a man play arm-wrestling	Symmetrical
A man and a woman toast (with their coffee cups)	Symmetrical
A woman and a man hold a rope from each end and spin the rope together	Symmetrical
A man and woman hold hands	Symmetrical

Intransitive fillers

A boy plays with a sword (to the camera)	Intransitive
A man dances alone to the camera	Intransitive
A boy waves hand to the camera	Intransitive
A man spins around a poll.	Intransitive
Two women standing side by side, one of them raises a cup	Intransitive
One man shakes his own hand	Intransitive
A woman holds a bag and walks alone	Intransitive

Irreversible transitive fillers

A man punches the wall	Irreversible transitive
A woman hugs a pillow	Irreversible transitive
Two men standing side by side, one of them taps the table	Irreversible transitive
A man collides into a poll	Irreversible transitive
A woman throws ball to the camera	Irreversible transitive
A man (facing camera) eats yogurt	Irreversible transitive
A man and woman (side by side) try to bend a nail on a wooden stick	Irreversible transitive

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