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Prosodic Marking of Information Status in Chinese Sign Language

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Abstract

In spoken languages, new information is often expressed with a longer word duration than given information. We investigate whether signers use the prosodic cue of duration to mark information status. Thirty-two deaf Chinese Sign Language (CSL) signers retold a story after watching a short cartoon clip. The data were glossed by a native CSL signer, with target references coded (e.g., different mentions of 'bear', 'stone'). We examined whether there was any reduction in the references based on information status. The results showed that first CSL signers primarily used nominals (24.0%), classifiers (42.1%), zero anaphora (30.0%), with minimal use of pointing (3.9%). Nominals were used in both the first and subsequent mentions, whereas classifiers, zero anaphora and pointing were almost always used in the non-first mentions. Furthermore, focusing on nominals, we compared sign durations across five mentions (M1 = 667.43 ms; M2 = 426.09 ms; M3 = 397.88 ms; M4 = 440.03 ms; M5 = 494.61 ms). A regression analysis revealed a significant linear and curvilinear relationship, indicating a gradient decrease in sign duration for the first three mentions followed by an increase for the fourth and fifth mentions. In conclusion, CSL signers not only use linguistic devices to track references but also vary the duration of nominals to mark information status.

Index Terms: Chinese Sign Language; prosody; information status; givenness; duration

1. Introduction

When talking about objects, events and people, we exchange information about these entities, or referents. If a referent is mentioned for the first time, it is usually new information; if the referent is referred to again after its initial mention, it becomes given information in the context. Such a change from new information to given reflects information status, and the varying degree of activation of the referent.

Chafe identified a three-way distinction in information status: active (given), semi-active and inactive (new) [1], depending on their accessibility [2]. Specifically, new information has not been mentioned yet previously and remains outside the addressee's awareness, or is currently inactive in any way, whereas given information is already present in the addressee's consciousness. Semi-active information is in the addressee's peripheral consciousness and is not directly focused on (e.g., a referent becomes deactivated from an earlier active state after being long out of the focus of attention, and is re-introduced into the discourse following a topic shift).

Similarly, Gundel *et al*. also believe that speakers adjust their speech according to the addressee's knowledge and attention state within the specific context [3], When introducing new information, speakers often expend more effort on information encoding to help the receiver decode it. However, to maintain given information, which is usually easier and more accessible for the receiver, speakers tend to use less effort. This may involve using less complicated forms, or conveying information in a more cost-effective way, such as using pronouns, zero anaphora, or reducing the duration of repeated words. For example, in a retelling of a story about an unlucky bear in English:

a. [A bear1] was walking on [a slope2].
b. [He1 kicked at [a rock3].
c. [The rock3] is hard.
d. [The bear1] got hurt and [Ø1] fell down.

When the bear is introduced for the first time, a noun phrase ('A bear1' in sentence a) is used. Then in sentence b, a pronoun is employed to maintain the referent, as it is already active and easily accessible from the preceding sentence. In sentence d, the noun phrase (or nominal) 'the bear' is re-introduced, albeit slightly removed from its first mention, with the word 'bear' likely having a shorter duration than its first mention. Additionally, in the same sentence, the referent is maintained by a zero anaphora.

The tracking of information is not only restricted in the morphosyntactic strategies, but also evident in the visual modality of gestures [4]. For example, new information is typically accompanied by gestures, while old information is often conveyed solely through speech [5], [6], [7].

Another visual mode of language is sign language, which has rich means of marking information status [8], [9], [10]. Apart from the common strategies like nominals, pronouns, and zero anaphora, classifiers also play a role [8], [9]. Frederiksen and Mayberry even further identified three subcategories of classifiers and looked at how they interact with information status [11] [12]. However, there is some confusion in the literature regarding zero anaphora, as it often co-occurs with other mechanisms such as constructed action (action performed by the signer as a role taking) [13] or classifiers [14], [15], [16].

Sign languages share some common features in reference tracking. For instance, American Sign Language (ASL) signers use bare nouns for both introduced referents and re-introduced discourse contexts and zero anaphora is used for reference maintenance [14]. By contrast, Turkish signers [9] also use nominals and extension classifiers for the first introduction.

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However, unlike spoken languages, pronouns are much less often used in sign languages [8], [9], [12], [14], [17].

Furthermore, both spoken and signed languages can use prosody to indicate information status. In speech, the degree of givenness can be reflected in the level of prosodic prominence [15]. For instance, the first mention of a referent is generally spoken with a wider pitch range and longer duration than the second mention of the same referent [18], [19], [20]. However, reintroducing a referent that has been absent from the center of focus for a while will often result in an increase in pitch range and duration [21].

As for sign language, articulators comprise the arms, hands, upper body, head, and face, which can be further subdivided into smaller units. Manual means such as tension and large articulation and the lengthening of signs are relevant along with nonmanual features to form articulatory arrays of the visual language system in the signing stream. Visual intonation is argued to be part of prosody that also functions as a linguistic device for grammatical marking or pragmatic usage [22], [23]. Prosody is key to marking information status [24], [25], [26], [27]. For example, squints in German Sign Language (DGS) are found to be used to mark given information [21]. Additionally, Van der Kooij et al. discussed focus marking from a prosodic perspective in Netherland Sign Language (NGT). They found that NGT focus is marked by modification of manual means, such as varying the size of articulation, raising the sign in space, and using repetitions [27]. Herrmann also shows that nonmanual features co-occur with zero marking, which added complexity to the situation [24].

Despite various means of prosodic marking of information status in sign language, no research has investigated how signers vary their sign duration in different mentions of the same references (but see two very recent studies on prosodic marking of focus in Turkish Sign Language [28] and phonetic reduction in a new young sign language [29]). According to Chafe's degree of activation/ givenness, if the distinction between new and given can be reflected in word duration in spoken language, and if referents with the highest cognitive accessibility are usually produced with minimal phonetic form [3], [30], we should also expect some duration adjustment in signs. Based on the literature above, this paper aimed to fill in the literature gap by investigating information status in Chinese Sign Language:

1) We first described the distribution of four major lexical devices: nominals, pronouns, classifiers and zero marking.
2) Prosodically, we studied how Chinese deaf signers used the duration cue to mark the different degrees of accessibility of nominal expressions in a discourse.

2. Method

2.1. Participants

Thirty-two deaf signers of CSL (17 females and 15 males) participated in the study. The mean age was 27.28 years old (SD = 6.52). Their education level ranged from primary school (n = 1), senior high school (n = 3), vocational college (n = 6) to university (n = 22). Twelve participants were born deaf, and the rest had a mean age of becoming deaf at 3.34 years (SD = 2.12). Their severity of hearing loss was mostly profound (n = 25), with four participants having severe hearing loss, one having moderate and one mild. All but two attended deaf primary school. The mean age of acquisition of CSL was 5.73 years (SD = 3.33). According to a 7-point-scale self-assessment, both their CSL proficiency (M = 5.67, SD = 1.21) and written Mandarin proficiency levels (M = 5.58, SD = 1.18) were quite high.

2.2. Materials

A short cartoon clip called 'I love picnic' was used as elicitation material. The clip depicted a polar bear embarking on a three-day holiday, each with a different theme. In the present study, we focused on the episode of the 1st day, which lasted about 1.5 minutes. In the clip, a polar bear walked up a hillside, unaware of a small stone on the road, and accidentally stumbled over it. The bear stared at the stone with great anger and purposefully hit it again. Shortly after, a large rock rolled down from the hill, prompting the bear to run downhill. When the bear came back by the small stone on the road again, this time he maneuvered around it carefully to avoid another collision. In a few seconds, the bear ran back and hid behind the small stone as more large rocks tumbled down from the hill. While the bear managed to dodge most of the rocks, he ultimately was hit by some rocks and rolled down from the hill. The content of the clip leads itself well to studying information status as it features several repeated mentions of different referents such as the 'bear', 'small stone', and 'rocks' etc. The video can be viewed at https://www.youtube.com/watch?v=tvtPalE-E6M&ab_channel=JUSTCruz.

2.3. Procedure

Participants were informed by an experimenter to carefully watch the cartoon clip and subsequently retell its content to another signer who had not viewed it. Using their mobile phones, participants recorded their sign narration. They were especially told to check the distance to the phone and ensure that all signs were clearly visible within the recording frame. After the task, demographic information such as age, sex, education was collected. All participants gave their consent to use their recordings for research purposes. As a token of appreciation for their help, participants received a small monetary reward. The study received ethical approval from Shanghai International Studies University.

2.4. Transcription and coding

Ex1 BEAR TRAVEL HILL CL:WALK^HILL

Translation: A bear travelled around on a hill, and walked on the slope along the hill.

Ex2. ONE STONE CL:FALL^STONE FINISH IX-3 ANGRY

Translation: There is a stone (on the road), (the bear) stumbled over the stone. He was very angry.

The sign narration of each participant was first glossed by a native deaf CSL signer in ELAN [31]. Then two bimodal bilingual researchers double checked the annotation and identified the nouns that could potentially be studied for

information status. These usually included full form signs such as 'bear', 'stone', 'rock', 'hill', 'slope', etc. (see BEAR, HILL in Ex1, STONE in Ex2). Apart from nominals, signers also used pointing as a pronoun, which was typically signed with an extension of the index finger. In addition, signers frequently used classifiers to track the references. A classifier was signed with either one hand or two hands. Take the classifier 'CL:WALK^HILL' (Ex1) as an example, the signer's left forearm is placed to refer to 'hill' while his index and middle fingers move along his forearm to refer to the whole event: 'the bear is walking along the hill'. Thus, classifier handshapes are used for reference. In our paper, zero anaphora includes two types: 1) constructed action, 2) complete pro-drop. Each reference was coded in two aspects: the forms (nominals, pointing, classifier, zero anaphora) and the number of mentions (1st mention, 2nd...) for nominals. For example, bear_ff_1st indicated that the nominal form of bear was signed for the first time.

Furthermore, we selected the nominals for further annotation to compare the duration of each occurrence of the noun phrases. To gloss their duration, we adopted Kendon's coding principle [32]: segmentation begins with the first movement of the dominant hand of the sign, and ends at the final movement before the hand moves to another sign. Elan automatically calculated the duration of the segmentations.

2.5. Data processing and analysis

The annotations of referents, including the durations of signs, were extracted from ELAN eaf files. First, we described the distributional differences in the use of nominals, pointing, classifiers and zero anaphora in marking information status by comparing their respective proportions. Zero markings consisted of two types: type 1 was constructed action, where signers used their entire bodies to mimic the action of the subject, or referred to as 'the bear'; type 2 was comparable to 'pro-drop' in spoken languages, where the subjects or objects were simply dropped without any other visible cues.

Second, focusing on nominals, we studied how signers varied the duration of full-formed nominals (dependent variable) across different mentions of the same referents. We excluded target referents with only a first mention (n = 54), as no other nominal mentions could be compared. We limited our analysis to up to five mentions of the nominals due to an insufficient number of observations beyond that (n = 18).

As the change in duration may not follow a linear pattern over different mentions, we used a linear mixed-effects model with polynomial terms for the number of mentions (linear and quadratic terms of Num.Mentions) in R. We included a random intercept for each participant but did not include a random intercept for the target word. This decision was based on the observation that adding them as control variables (only 8 target referents) resulted in better model fitness, as indicated by a comparison of their AIC values (3835.6 vs. 3841.1, χ^2 (6) = 17.6 p = .007). The main effects remained significant in both models.

3. Results

Overall, there were 1436 data points of references, consisting of 342 nominals, 604 classifiers, 56 pronouns (pointing), 431 zero anaphora, and 3 mixtures of both a classifier and a point (excluded in the analysis due to the few cases). The distribution of four types of marking information structure was significantly different than the chance level, χ^2 (3) = 439.09, p < .001. As shown in Figure 1, classifiers accounted for the largest proportion, which was more frequent than that of the zero anaphora, χ^2 (1) = 28.92, p < .001, and the nominals, χ^2 (1) = 72.56, p < .001. The frequency of nominals was significantly higher than that of the pointing, χ^2 (1) = 205.52, p < .001, but lower than that of the zero anaphora, χ^2 (1) = 10.25, p = .0014. Furthermore, the majority of the zero anaphora was constructed action (73.5%, n = 317), which was significantly more prevalent than the pronoun drops (26.5%, n = 114), χ^2 (1) = 95.61, p < .001.

The nominals were both used in the first (40.1%) and subsequent mentions (59.9%) whereas classifiers (96.7%) and constructed actions (99.7%) were almost always used in the non-first mentions. Pointing and the other zero anaphora (pro-drop) were only used in the non-first mentions (100%).

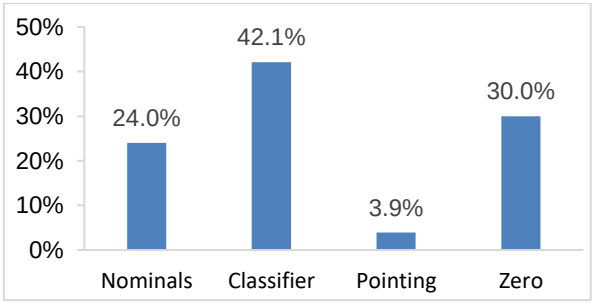

Figure 1: *The proportion of nominals, classifiers, pointing, and zero anaphora by deaf signers of CSL in reference tracking.*

As for the durations of different mentions of nominals for full-form signs, Table 1 shows their descriptive statistics up to five mentions. They displayed a gradual decrease in duration from the first to the third mentions, while there was an increase for the fourth and fifth mentions of the same nominals.

Table 1: *Mean durations of nominals over five mentions.*

Mentions	Duration	SD
First	667.43 ms	377.66 ms
Second	426.09 ms	248.15 ms
Third	397.88 ms	240.16 ms
Fourth	440.03 ms	287.92 ms
Fifth	494.61 ms	274.60 ms

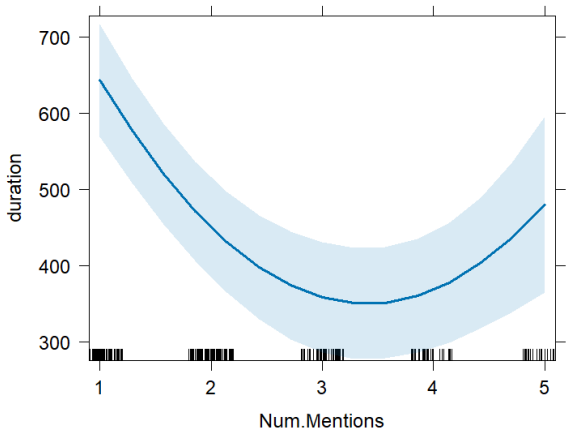

Figure 2: *Predicted effect of mean durations of a full-formed sign over five mentions, with 95% confidence intervals (shaded bands). The rugs indicate the distribution of the data.*

Regression analysis showed that the linear term of Num.Mentions (poly(Num.Mentions, 2)1) was significantly negative (β = -1324.6, SE = 277.4, t = -4.78, p < 0.001), suggesting a decreasing trend. By contrast, the quadratic term of Num.Mentions (poly(Num.Mentions, 2)2) was significantly positive (β = 1296.8, SE = 264.8, t = 4.90, p < 0.001), indicating a subsequent increase in duration after the initial decrease. These results suggest that the number of mentions has a significant impact on the duration of full-formed signs, exhibiting a nonlinear relationship with an initial decrease followed by an increase. Figure 2 plots the predicted effect of the number of mentions in the model.

4. Discussion

In this study we explored how deaf CSL signers employed different strategies, such as nominals, classifiers, pointing and zero anaphora to track references in discourse. Focusing on the full-formed signs, we further investigated the prosodic marking of these references across different mentions. We found that the sign duration was reduced in the first three mentions but increased in the fourth and fifth mentions.

First, CSL deaf signers mostly used nominals, classifiers and zero anaphora (mainly constructed actions) to mark information status whereas pointing was only sparsely used. Apart from nominals, all other means were predominantly used in the non-first mentions of a referent. There were several exceptions for a classifier to be used as a first mention. For the only case in the constructed action, the signer 'forgot' to use a full nominal to name the referent BEAR but used a constructed action to refer to it. This also occurred once in the use of a classifier for the first mention. Neither is common in reference tracking as it is not an optimal way of communicating. A further examination of other cases of first-mentioning classifiers showed that they were mainly of two types. First, it was obvious in the context what the classifier referred to. For example, referring to a stone on a hillside could be easily activated according to the environment. This is in line with so-called situational accessibility [2] (e.g., the concept of a waitress is activated in a restaurant). Second, the referent was inferable from an already active or accessible referent. For example, after mentioning a small stone on the hillside, the concept of a stone became accessible and therefore the use of a classifier to refer to a big rolling rock became *inferentially accessible*.

Second, focusing on the full nominals, we showed for the first time how deaf signers use the durational cue to mark the different mentions. Past research on repeated references in Dutch Sign Language has shown that when signers described figures to an addressee repeatedly, the repeated references were shorter, and contained fewer and shorter signs than initial references [33]. Consistent with this finding, our study showed that the first mention of a nominal was longer than subsequent mentions in spontaneous sign narration. We observed a gradient decrease in duration over the three mentions of nominals. This is in line with the cognitive activation of a reference that different degrees of givenness can be marked by prosodic prominence. The first mention is new information, which is produced with the longest duration, whereas the second mention is given which leads to a reduction in sign duration. As the reference becomes even more accessible in the third nominal mention, the duration of the sign is further attenuated.

Interestingly, in a perception experiment Hoetjes et al. showed that signs produced in repeated references were not considered to be less precise than signs produced in initial references as judged by native signers (unlike spoken languages) [33]. As that perception study was on the repeated whole reference rather than the repeated nominals, it remains to be seen whether signing addressees are sensitive to such reductions. For example, future research can compare signers' reaction time and accuracy in judging the meaning of different mentions of the same nominals.

Furthermore, we also showed that there was a significant trend of increase in duration for the fourth and fifth mentions. This could be due to two reasons. First, the reduction in duration has reached its floor level. Like word duration in spoken language, the duration of a sign will not reduce further after reaching its minimal requirement for communicative intelligibility (e.g., fewer movements, smaller size, one hand, phonetic reduction in hand shapes, orientation and trajectory).

If this is the sole reason, we would expect that the duration of the nominal sign should level or slightly fluctuate around a duration after the third or fourth mentions. Nevertheless, the fourth and fifth mentions had significantly increased durations. Particularly, the fifth mention (494.61 ms) seemed to be even longer than the second mention (426.09 ms). This indicated that there may be a re-introduction of the reference. It could be the case that the reference has been out of centre of focus for a while, thus becoming accessible information (half new). Thus using a nominal to re-introduce the reference could result in high prosodic prominence. In addition, it could simply be due to the fact that there was a long interval between the two mentions of nominals, even though the reference was maintained with other non-nominal means. Further coding and analyzing temporal distances, the number of other referents introduced, as well as number of non-nominals used between the nominal mentions can help better understand the durations.

Due to limited data, we did not examine the effect of CSL signers' proficiency on their distribution of reference tracking or their durational marking of nominals. Past research on spoken language showed that second language learners with an intermediate proficiency level tend to be overspecified in reference tracking by overusing full nouns and accentuating given information [4], [18]. Some studies in sign languages have explored the different categorical distribution between native vs non-native signers [34], as well as among early learners [35]. It would be intriguing to investigate whether CSL signers of varying proficiency levels use full nominals differently [36] and whether there are any differences in the prosodic marking of information status. Additionally, other aspects of prosodic marking of the nominals such as the size of the sign (intensity/saliency) can also be investigated.

5. Conclusions

We show that CSL signers used nominals, classifiers, pointing and zero anaphora to track references in discourse. The first mentions are primary nominals and signers use sign duration to mark the distinction between new and given information, while a re-introduction of references results in a climb in duration. In conclusion, the degree of accessibility of a nominal is marked by the duration of a sign in CSL.

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