Reduction in Repeated References in Gesture and Sign Language.

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Abstract. Previous research has shown that predictable information in speech is often reduced, with regard to its quantity but also with regard to its quality. The present study aims to find out whether reduction also occurs in speech-accompanying gestures and in signs. To this end, a director-matcher task was set up in which speakers of Dutch and speakers of Sign Language of the Netherlands (NGT) took part. In this task the director had to refer to the same object several times. The repeated references thus obtained were analysed for their reduction using a novel methodology. Gesture results suggest that gestures can be reduced in the same way as speech, namely both in their quantity and in their quality. Results for NGT show reduction in the quality of the signs being produced.

Keywords: reduction; gesture; sign language; repeated references

1 Introduction

It is known that when speakers refer to the same object more than once, reduction occurs. This can be apparent in conceptual pacts [1], but also in reduction in word duration, e.g. [2], number of words, e.g. [3], and in acoustic reduction, e.g. [4, 5]. Research has shown that this reduction may be due to speakers' tendency to keep information density constant throughout speech [6], which means that predictable information such as a reference that has already been mentioned is often reduced. Given that communication does not only consist of speech but also of nonverbal aspects, one may wonder whether a similar process takes place for gestures and sign language in repeated references. Question then is, does gesture reduction occur in the same way as speech reduction (as one would predict based on gesture models such as proposed by Kendon and McNeill [7, 8], where there is a direct link between speech production processes and gesture) or is gesture reduction a process that is more independent from speech? Also, since the informational status of signs in sign language differs from that of speech-accompanying gestures, reduction in repeated

signs could be different from reduction in repeated spontaneous gestures. And, importantly, how can we quantify reduction in gestures and sign language?

There has not been much previous work on reduction in gesture and sign language. The little previous work on reduction in gestures that has been done has looked at the number of gestures, [9], semantics of gestures, [10], and size of gestures, [11]. The only previous experimental study looking at reduction in sign language that we know of, [12], looked at sign lowering as an effect of phonetic context and signing rate.

2 Method

To study reduction in repeated references in gestures and sign language, two data sets, one containing gestures and one containing sign language, were created. These data sets consist of recordings of participants taking part in a director-matcher task. In this task, the director had to describe a figure in such a way to the matcher that the matcher could identify the figure from a range of similar looking figures. In the stimuli, there were several figures that had to be described two or three times, leading to repeated references to the same item. This task was done by native speakers of Dutch (N=48) and by speakers of Sign Language of the Netherlands (N=14).

For the gesture data set we conducted a new methodology by looking not only at the number of gestures, as has been done in [9], or size, as has been done in [11], but also at several new ways to analyse reduction in the quality of the gestures. Using the ELAN annotation tool [13], we looked at gesture duration and several aspects of the form of the gestures, namely, the number of hands that were used in producing each gesture, the part of the body that was used for each gesture, the number of stroke repetitions within the same gesture and the visibility of the gesture for the addressee. Moreover, in order to measure gesture precision, a perception test was used, in which a new group of participants (N=23) was presented with 66 pairs of video clips of two gestures by the same participant about the same object but produced during either the initial (one video clip) or the repeated (the other video clip) description of the object. The participants in the perception test were then asked to judge, in a forced choice task, which gesture they considered to be more precise.

For the sign language data set we have looked at the duration of the stimulus description, the number of signs that was used, the proportional number of signs and the sign duration. Moreover, in order to measure sign precision, a perception test was used that was set up in the same manner as with the gesture data but where participants (N= 27) had to judge, in a forced choice task, which *sign* they considered to be the most precise, looking at 40 pairs of video clips with signs produced in either initial or repeated references to the same object by the same signer.

3 Results

For the data set of native speakers of Dutch, speech and gesture analysis has taken place for the first and third reference to the objects that had to be described three

times. It was found that speakers take significantly less time ($F_{(1, 47)} = 40.75$, $p < .001$) and use significantly fewer words ($F_{(1, 47)} = 37.28$, $p < .001$) in repeated references compared to initial references. When we look at the number of gestures that were produced we see that speakers produce significantly fewer gestures during repeated references compared to initial references ($F_{(1, 47)} = 22.75$, $p < .001$), but that this decrease is smaller for gestures than for the number of words ($F_{(1, 47)} = 4.04$, $p = .05$). A subset of the data, in which all participants produced at least one gesture for each initial and repeated reference, has been analysed with regard to the quality of the gestures. We found that gestures produced during repeated references are smaller ($F_{(1, 22)} = 5.42$, $p < .05$) and more often one-handed ($F_{(1, 22)} = 8.21$, $p < .05$) than the gestures produced during initial references. A perception test showed that gestures produced during repeated references were considered to be less precise than the gestures produced during initial references ($t_{(65)} = 2.66$, $p < .05$). The other variables taken into account (gesture duration, repetition within the gesture, visibility of the gesture) did not show significant effects.

For the data set of speakers of Sign Language of the Netherlands, sign analysis has taken place for the first and third reference to the objects that had to be described three times. It was found that speakers take significantly less time ($F_{(1, 13)} = 35.15$, $p<.001$) and produce significantly fewer signs ($F_{(1, 13)} = 42.51$, $p<.001$) in repeated references compared to initial references. The proportional use of signs (number of signs divided by duration), however, stays the same across initial and repeated references, showing that sign reduction in repeated references is only due to the reduction in duration. However, results also showed that the duration of the signs themselves is reduced ($F_{(1, 13)} = 15.10$, $p<.01$) in repeated references compared to initial references. A perception test showed that signs produced during repeated references were considered to be less precise than the signs produced during initial references ($t_{(39)} = 4.54$, $p<.001$).

4 Conclusions

We found that gestures in repeated references are reduced with regard to their overall number, the number of hands that are used, their size and their precision. These results show for gestures in repeated references what previous findings have found for speech in repeated references, namely that they can be reduced both in their quantity (their number) and in their quality (their realization). Based on the present findings, it seems that gestures can be reduced in ways similar to reduction in speech. For the data set of speakers of Sign Language of the Netherlands, we found no reduction for the proportional number of signs in repeated references, but we did find that repeated signs are reduced with regard to their duration and their precision. These results show that signs can be reduced with regard to their quality. Based on the present findings, it seems that reduction in sign language is different from reduction in speech or reduction in gesture.

The present study has shown that it is possible to quantify reduction in gestures and in sign language. Several aspects of nonverbal reduction still remain unstudied, especially with regard to sign language, where presently only a small number of

aspects has been taken into account. However, overall, we can conclude that repeated references lead to reduction, not just when we look at verbal aspects of communication but also when we take nonverbal aspects such as gesture and sign language into account.

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