Gesture-sign interface in hearing non-signers' first exposure to sign

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Abstract

Natural sign languages and gestures are complex communicative systems that allow the incorporation of features of a referent into their structure. They differ, however, in that signs are more conventionalised because they consist of meaningless phonological parameters. There is some evidence that despite non-signers finding iconic signs more memorable they can have more difficulty at articulating their exact phonological components. In the present study, hearing non-signers took part in a sign repetition task in which they had to imitate as accurately as possible a set of iconic and arbitrary signs. Their renditions showed that iconic signs were articulated significantly less accurately than arbitrary signs. Participants were recalled six months later to take part in a sign generation task. In this task, participants were shown the English translation of the iconic signs they imitated six months prior. For each word, participants were asked to generate a sign (i.e., an iconic gesture). The handshapes produced in the sign repetition and sign generation tasks were compared to detect instances in which both renditions presented the same configuration. There was a significant correlation between articulation accuracy in the sign repetition task and handshape overlap. These results suggest some form of gestural interference in the production of iconic signs by hearing non-signers. We also suggest that in some instances non-signers may deploy their own conventionalised gesture when producing some iconic signs. These findings are interpreted as evidence that non-signers process iconic signs as gestures and that in production, only when sign and gesture have overlapping features will they be capable of producing the phonological components of signs accurately.

Keywords: sign language, iconic gestures, iconicity.

Introduction

After more than five decades of research devoted to the description of sign languages there is no room to doubt they are fully fledged languages in their own right. They have the same expressive power as spoken languages and present the same linguistic levels (phonology, morphology, syntax). A salient property not commonly found in speech, however, is the ability to depict perceptual features of their referent (iconicity) (Perniss, Thompson, & Vigliocco, 2010). Signs often adopt the form of the referent making it possible to associate the sign with its meaning without knowledge of a sign language. This feature can be attributed to the visual modality permitting more referent mappings than those possible in speech. This property is shared by the iconic gestures used by the speaking community because they can also adopt the form of a referent to facilitate communication. In this paper we will argue that experience with iconic gestures interferes in non-signers' ability to discriminate iconic gestures from signs and that during production non-signers tend to render their own conventionalised gesture.

Stokoe's work on American Sign Language (ASL) was the first to suggest that signs were not a random collection of gestures but rather consisted of systematic meaningless parameters (i.e., handshape, location, movement and orientation) (Stokoe, 1960). These phonological constituents assemble to represent signs with clear mappings to their referent (iconic signs) or they can have no obvious relationship (arbitrary signs).

Iconicity in signs has been an important focus of attention for its potential role in the acquisition of a sign language. Most research has consistently reported that it does not assist deaf children in learning a sign language from their signing caregivers (Conlin, Mirus, Mauk, & Meier, 2000; Marentette & Mayberry, 2000). In contrast, there is robust evidence that iconic signs are more memorable to adult non-signers despite their inexperience with a visual phonology.

Lieberth and Gamble (1991) compared the ability of non-signers to recall arbitrary and iconic signs after a short and long period of time. Over a short period non-signers were able to recall arbitrary and iconic signs with comparable ease but over an extended period there was a significant drop in recall of arbitrary sign. Campbell, Martin and White (1992) further replicated these findings by applying a forced choice recognition task to non-signers and hearing learners of British Sign Language (BSL). It was found that highly iconic signs were more easily recognised than signs with lower iconicity ratings by both groups of participants. This demonstrates that despite no prior exposure to a sign language, ease of interpretation of iconic signs correlates with better recall. More recently a study found that iconicity has a facilitation effect during translation tasks in non-signers (Baus, Carreiras, & Emmorey, 2012). After learning a set of iconic and arbitrary signs in American Sign Language (ASL) participants were asked to produce forward and backwards translations (English-ASL and ASL-English) and to match word-sign equivalents while their response times were measured. In both tasks participants were faster and produced fewer errors for iconic than arbitrary signs. Together these studies show that iconicity is a key feature that makes signs more memorable to non-signers yet the exact cause behind this preference remains to be further explored.

The property of iconicity is also exploited during speech. Iconic gestures are manual structures occurring in high synchrony with the spoken utterance (McNeill, 1992), they aid lexical retrieval (Krauss, 1998) and they are automatically integrated with speech to facilitate comprehension (Kelly, Creigh, & Bartolotti, 2010; Kelly, Manning, & Rodak, 2008). Apart from defining the

relevance of iconic gestures during communication, these studies demonstrate that non-signers have a wealth of experience in processing and producing iconic gestures for communicative purposes. Despite iconic signs and gestures converging in their capacity to encode physical attributes of a referent, a clear distinction is that only signs are highly conventionalised and consist of specific phonological components.

A recent study investigating the ability to discriminate the phonological constituents of signs suggests that non-signers' tend to exploit their gestural experience when processing iconic signs from a natural sign language (Ortega, 2012). In the study, participants viewed a set of iconic and arbitrary signs and were asked to imitate them as accurately as possible. After coding for how precise each sign component (handshape, location and movement) was articulated, it was found that accuracy was significantly lower for iconic than arbitrary signs. Because iconic and arbitrary signs were balanced for phonological complexity, this difference was explained by non-signers processing iconic signs as iconic gestures (i.e., without phonological mediation).

In order to further investigate the effect of iconicity, five hearing non-signers from the same sign repetition task were summoned to take part in a sign generation task. Participants were asked to make up a sign from the English translation of the iconic signs they imitated six months earlier. The aim was two-fold. First, to determine whether participants' own gesture had any similarities with the real BSL sign; and second, to establish whether they produced the same handshapes (i.e., the same articulation error) at both points in time. Together these two factors would explain whether participants interpreted the real BSL sign as their own iconic gesture and would confirm whether their articulation errors stem from the structural similarities between both. If the same handshapes were produced in the sign repetition/generation tasks it would be evidence that non-signers have a retrievable gestural representation and that can be deployed when imitating iconic signs.

Methodology

Participants

Five hearing adults (two female, mean age: 26.4 years, range: 21-35) with no prior experience with BSL or any sign language were recruited for the study. These participants took part in a sign repetition task six months prior to the present study.

Procedure

Participants were told that this was a follow-up of the study on sign languages acquisition they took part in six months earlier. They were instructed to conceive and produce a sign based on the word displayed on a computer screen. The words (n = 48) were the closest translation of the iconic signs they imitated in the sign repetition task. The trial started with a fixation point in the middle of the screen. Then, the English translation of an iconic BSL sign was displayed for two seconds after which participants were allowed four seconds to generate a sign. The following word came immediately after so as to force participants to produce their most intuitive response. Participants were tested in a quiet room in front of a 15'' laptop. A Sony Handycam DCR-HC51 was located 1.5 m from participants at a 45 degree angle to record all sign repetitions.

Data analysis

The handshapes produced in the sign repetition task were compared to the real BSL sign to obtain a measure of articulation accuracy in sign imitation. When the sign imitated and the real BSL target had the same hand configuration they were given a score of 1 and 0 if they were different. Similarly, the handshape of each generated sign was compared to the real BSL equivalent. This would provide with a measure of overlap between BSL sign and generated sign. A score of 1 was given if participants' rendition exhibited the same hand configuration as the real BSL sign and 0 if it was different (see Figure 1).

Figure 1: Comparison of BSL signs with renditions from a sign repetition and a sign generation task. Articulation accuracy will be higher when the generated sign overlaps with the real BSL sign but it will be hampered when they present different hand configurations.

By comparing these measures, it would be possible to determine whether the gestures generated[1] by non-signers are a predictor of articulation accuracy in the phonological parameters of BSL signs. The more overlap between gesture and the BSL sign the more accurate participants will be in articulating a sign. The more disparate the gesture is from the sign, the less accurate they will be in sign articulation.

[1] It is clear that these are not real iconic gestures. However, the signs generated are good approximation of what participants would produce in a naturalistic context.

Results

The scores for both measures (i.e., articulation accuracy of the handshape and overlap between the generated sign and the BSL handshape) were averaged across participants with 5 being the highest possible score and 0 the lowest. The mean articulation accuracy for the sign repetition task was 2.40 (SD = 1.34) and the overlap between self-generated signs with BSL handshape was 2.27 (SD = 1.64). The values for articulation accuracy were rank ordered and compared with the measure of self-generated sign's handshape overlap with BSL. A Pearson product-moment correlation coefficient revealed that there was a significant correlation between these two measures ($\rho = 0.507$, $n = 48$, $p < 0.000$) showing that participants were accurate in articulating a BSL sign when the signs they generated displayed the same handshape as the BSL sign.

A follow-up analysis involved the comparison between the self-generated sign's handshape overlap with BSL and the BSL sign's independent iconicity ratings with different non-signers. In the scale 1 denoted signs with low iconicity and 7 signs with high iconic mappings. A Pearson product-moment coefficient revealed that there was a significant correlation between self- generated signs' handshape overlap and iconicity rating ($\rho = 0.533$, $n = 48$, $p = 0.001$). This is interpreted as BSL signs being more likely to be regarded as iconic if they have overlap with the gestures generated by hearing non-signers. These data suggest that a significant number of iconic BSL signs overlap with the form of non-signers' rendition of the same concept.

Discussion

The aim of this study was to further investigate the role of iconic gestures in the production of iconic BSL signs. After comparing the renditions from a sign repetition and a sign generation task it was found that there was a significant overlap between the handshapes of the sign generated and the actual BSL sign. The data also revealed that articulation accuracy correlates with overlap with BSL signs. In other words, the more overlap between gesture and the BSL sign (e.g., Figure 1a and 1b) the more accurate participants will be at articulating iconic signs. In contrast, participants will be less successful at the repetition task when iconic sign have less overlap with their own gesture (e.g., Figure 1c and 1d). These results suggest that articulation accuracy could be predicted by the overlap between iconic signs and gestures.

The structural consistencies observed within participants' renditions and BSL can be explained by iconic gestures and signs exploiting the visual modality to express meaning. A salient feature of all sign languages is that they use visual information to depict a concept. They do so by selecting salient features of a referent, schematising their properties and encoding them into a sign form (Taub, 2001). This explains why so many signs overlap in form in many unrelated sign languages (Emmorey, 2001). The present data suggests that the generation of iconic gestures follows a similar process. A similar process is observed in the hearing-speaking community in that they select a relevant visual feature of a referent to generate an iconic gesture (Caldognetto & Poggi, 1995). This gives the appearance that iconic gestures and signs are equivalent structures. However, despite non-signers and signers converging in their choice to depict some referents they differ in that only signs have conventionalised building blocks (i.e., phonology).

Our data also suggest that for signs with high iconicity ratings, non-signers tend to produce the same handshape as they did six months prior. Because there is a wide gap between both testing sessions, and because the same handshape tended to occur in signs overlapping across participants, this may be evidence of these being retrievable iconic gestures. Some types of gestures have mental representations (Gunter & Bach, 2004) with some even showing basic grammatical properties (Goldin-Meadow, Butcher, Mylander, & Dodge, 1994). To date there is no evidence that the same is true for iconic gestures. However, because participants produced the same handshapes for highly iconic signs it could be indication that these have conventionalised representations with stable structures.

Ease of recall (Baus et al., 2012; Campbell et al., 1992; Lieberth & Gamble, 1991) and inaccuracy to produce some of the exact phonological constituents of iconic signs (Ortega, 2012) could thus be explained in terms of gestural interference. When viewing iconic signs, non-signers can access their iconic features (arguably via their expertise in perceiving iconic gestures) ignoring the exact sign phonological structure. At the moment of imitating iconic signs, participants retain their memorable iconic elements but disregard their exact phonological components. Arbitrary signs, in contrast, cannot be mapped onto a familiar gesture or referent making them less memorable, and for the same reason, their sign components are processed and articulated more accurately.

There are two alternative explanations behind the preference to recall iconic signs and to articulate them less accurately. Given that some iconic gestures and signs have overlapping forms with only subtle structural differences, it may be that participants matched their own conventioanlised gesture with the BSL sign and produced it *en lieu* of the sign. Alternatively, participants detected the iconic feature of the sign, but imitated it inaccurately because they lack a visual phonological system. The present data suggest that these explanations are not mutually exclusive but rather complement each other. Some iconic gestures are highly consistent within participants and, contrary to other views regarding the representation of iconic gestures (Caldognetto & Poggi, 1995), may have a retrievable gestural representation. This seems not to be true for less iconic gestures.

These results have important implications in the context of the acquisition of a second language (L2) in the spoken and visual modalities. There is evidence that learners of a spoken L2 are more successful at learning novel words

when they are taught with matching gestures (Kelly, McDevitt, & Esch, 2009). This has been attributed to iconic gestures facilitating a link between an arbitrary word and a visual referent. This claim is likely to hold in sign L2 acquisition. Iconic signs will be more memorable because they have an obvious link with their referent. However, a significant difference is that learners will have to move away from relying on the image evoked by iconic signs and focus in their phonological constituents. Paradoxically, it seems iconic gestures will facilitate sign-referent mappings but will hamper phonological acquisition.

In sum, the present data suggest that experience in processing and articulating iconic gestures has an effect on the production of iconic signs. The data also suggest that given the level of consistency observed in the iconic gestures produced by non-signers, they may be part of a conventioanlised set of iconic gestures.

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