Transparency in Sign Forms: When and How Does Iconicity Matter?

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Abstract

Research suggests that the meanings of iconic signs are not easily guessable by sign-naive people; however, some signs' meanings are more easily guessed than others'. What causes some signs to be more easily guessable (more *transparent*) than others is not well-understood. In our previous research, we showed that signs whose form is based on more cross-linguistically common underlying motivations were chosen as "better suited" to a meaning—that is, they are more transparent—than signs based on less common underlying motivations (Tkachman, Sadlier-Brown, Lo, & Hudson Kam, 2023). In the current study, we ask whether, in addition, iconicity affects a sign's transparency. We asked sign-naive English speakers to rate all the signs from our previous study for how iconic they are. We then reanalyzed the data from our previous study in light of the obtained iconicity ratings. Results show that when people are asked to choose between an attested sign for a given animal label and an unattested one (i.e., a sign for a different animal), iconicity ratings did not affect participants' preferences: attested signs are preferred regardless of how iconic they are. However, when participants are asked to choose between two attested signs with the same meaning (e.g., two signs for 'cat' from different sign languages), iconicity does appear to affect participants' choices: participants were more likely to pick the more cross-linguistically common sign if the difference in iconicity ratings between the two signs was bigger. These results shed additional light on the ongoing debate on the connection between iconicity and transparency: iconicity by itself does not make a sign transparent, but it can enhance transparency under certain conditions.

Keywords: iconicity; sign languages; transparency; cross-linguistic frequency

Introduction

Iconicity is *perceived* resemblance; that is, words or signs that are iconic suggest a resemblance to their referent in a human perceiver (see Figure 1). As such, iconicity is not an inherent property of iconic words or signs; instead, the degree to which a sign resembles its meaning crucially depends on who is judging the resemblance. Despite this, the meaning of some signs does seem to be more guessable than others by sign naive perceivers. The degree to which a meaning is guessable is referred to as a sign's transparency: the easier it is for people who do not know the meaning of the sign to guess its meaning correctly, the more transparent the sign is considered to be (Klima & Bellugi, 1979). What causes some signs to be more transparent than others is unclear. Studies consistently show that people without prior knowledge of sign languages can guess some iconic signs correctly, but also that the percentage of successful guesses is low, and the ability to guess signs' meaning is inconsistent, with specific signs guessed correctly by some people but not others (Klima & Bellugi, 1979; Pizzuto & Volterra, 2000; Lai & Yang, 2009; Ortega, Schiefner, & Özyürek, 2019; Sehyr & Emmorey, 2019). And because an iconic sign can be motivated by various aspects of its referent (e.g., the form of a sign for CAT can be motivated by the cat's whiskers, or claws, or grooming behaviour, etc.), perceivers often guess an incorrect though semantically related meaning (e.g., see Sehyr & Emmorey, 2019). Likewise, the same form can have different plausible interpretations. Taken together, these results suggest that no iconic sign is entirely transparent.

That does not mean that iconicity plays no role in transparency, however. Our study seeks to better understand the relationship between the two. Specifically, we ask whether more transparent signs are necessarily more iconic than less transparent signs. We examine this in animal signs, a type of signs that is generally highly iconic across languages, but where the specifics of the iconic representation vary. Importantly, this leaves room for varying degrees of iconicity, and of transparency, allowing us to examine the nature of the relationship between the two within this class of signs.

Iconic signs can be described in terms of their underlying motivations, that is, which semantic aspect of the referent is used to motivate the signs' form (e.g., 'whiskers' for CAT as described above). Underlying motivations are distinct from forms: 'whiskers', for example, can be represented in multiple distinct ways, only one of which is correct within a specific sign language. Thus, although the specifics of the iconic representation are different from language to language, the underlying motivations for a meaning can be the same. Notably, these underlying motivations vary in frequency: some motivations are more common than others for the same meaning when we look across languages (Tkachman et al., 2023).

In our previous research, when sign-naive people were asked to pick a sign that was better suited for a particular meaning, they tended to pick the sign form that was based on a more cross-linguistically common underlying motivation over the sign form with the same meaning but based on a less cross-linguistically common motivation (Tkachman et al., 2023). In the present study, we ask whether iconicity is also involved in the choices people make while choosing a sign suited to a meaning. We asked a different group of sign-naive participants to rate the signs used in the previous study

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for how iconic they are. We then reanalyzed the data from our previous study with the iconicity ratings included as a predictor.

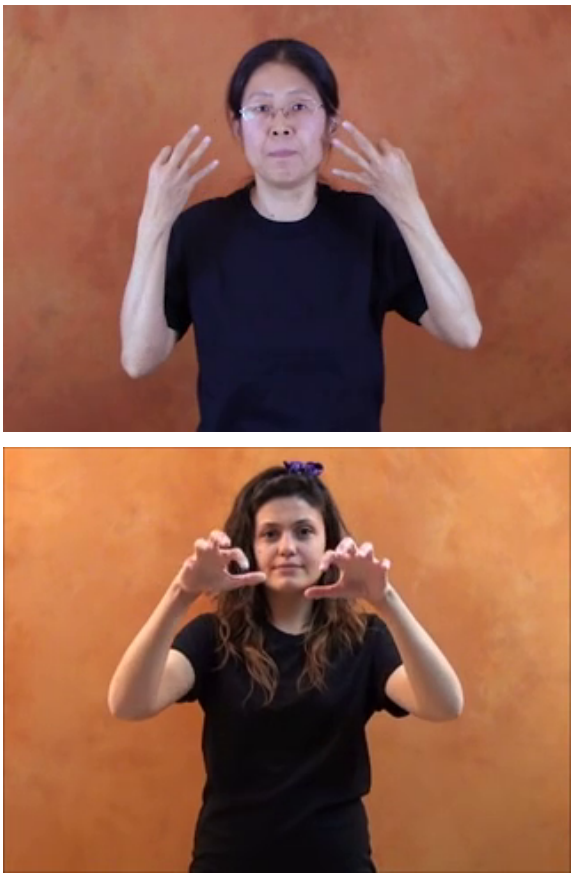

Figure 1: The Chinese Sign Language sign for CAT (top) and the Turkish Sign Language sign for BEAR (bottom). Images from the Spread the Sign corpus (used with permission).

Methods

Participants

104 participants, from a variety of language backgrounds, were recruited at a North American public university. Participants received course credit for their participation.

Stimuli

Stimulus items for the present study are the same as those in Tkachman et al. (2023). Stimuli consisted of video clips of animal signs for a set of 20 animals from the cross-linguistic online sign language dictionary *Spread The Sign* (www.spreadthesign.com). The animals were: BAT, BEAR, BEE, CAT, CATERPILLAR, DINOSAUR, DOG, GOLDFISH, FROG, GORILLA, HORSE, KANGAROO, LION, OSTRICH, MOUSE, ROBIN, GIRAFFE, ALLIGATOR, SNAKE, WHALE. At the time of stimuli preparation, the corpus had entries for 33 languages, though not every sign language in the corpus had entries for all 20 animals included in the study.[1] All signs for a given animal were coded for underlying motivation, and then three signs for each animal were chosen: a sign that used the cross-linguistically most frequent underlying motivation (labeled T1), a sign that used the cross-linguistically second most frequent underlying motivation (labeled T2) and a sign that used the cross-linguistically least frequent motivation (labeled T3). The particular sign chosen was selected according to an algorithm designed to include as much as possible an equal number of signs for each language. Selection was not based on or directly sensitive to iconicity. See Tkachman et al. (2023) for more details on selection. The stimuli selection process yielded a set of 60 signs (20 animals $\times$ 3 underlying motivations) from a variety of sign languages; this was the stimuli set used in both Tkachman et al. (2023) and the current study.

Procedure

The experiment was conducted online using jspsych v6.3.0 (de Leeuw, 2015), with participants completing it on their own devices. In the first stage of the experiment, we explained the concept of iconicity to participants using the following wording, accompanied by video clips of ASL signs for DRINK, BROTHER and BALL: "some signs look like what they mean. For example, the sign for DRINK is generally thought to be very iconic, because it looks like a person holding a cup and bringing it to their mouth. A person who does not know sign language might be able to guess this sign's meaning. Other signs are not iconic at all; for example, the sign for BROTHER does not look like a brother. Signs can be iconic for different reasons. Some signs, like the sign for DRINK, show the way an object is used. Other signs, like the sign for BALL, show the shape of the object." The three particular examples were chosen because they were irrelevant to the stimuli, which entirely consisted of animal signs, and therefore were unlikely to bias participants' responses.

Participants' task was to watch each animal sign video clip, and rate it on a 7 point Likert scale for "how iconic [it is]", with 1 being "not iconic at all" and 7 being "extremely iconic" (see Figure 1 for some examples of the stimuli). The experiment started with a training period, in which participants practised the task by rating three signs of animals not included in the study. This was followed by the experimental task, in which participants rated the 60 animal sign video

[1]The data came from the following 33 sign languages: American Sign Language; Argentinian Sign Language; Austrian Sign Language; Belorussian Sign Language; British Sign Language; Bulgarian Sign Language; Chilean Sign Language; Chinese Sign Language; Croatian Sign Language; Cuban Sign Language; Czech Sign Language; Estonian Sign Language; Finish Sign Language; German Sign Language; Greek Sign Language (Cyprus); Greek Sign Language (Greece); Icelandic Sign Language; Indian Sign Language; International Sign Language; Italian Sign Language; Japanese Sign Language; Latvian Sign Language; Lithuanian Sign Language; Mexican Sign Language; Polish Sign Language; Portuguese Sign Language; Romanian Sign Language; Russian Sign Language; Slovak Sign Language; Spanish Sign Language; Syrian Sign Language; Turkish Sign Language; Ukrainian Sign Language; Urdu Sign Language.

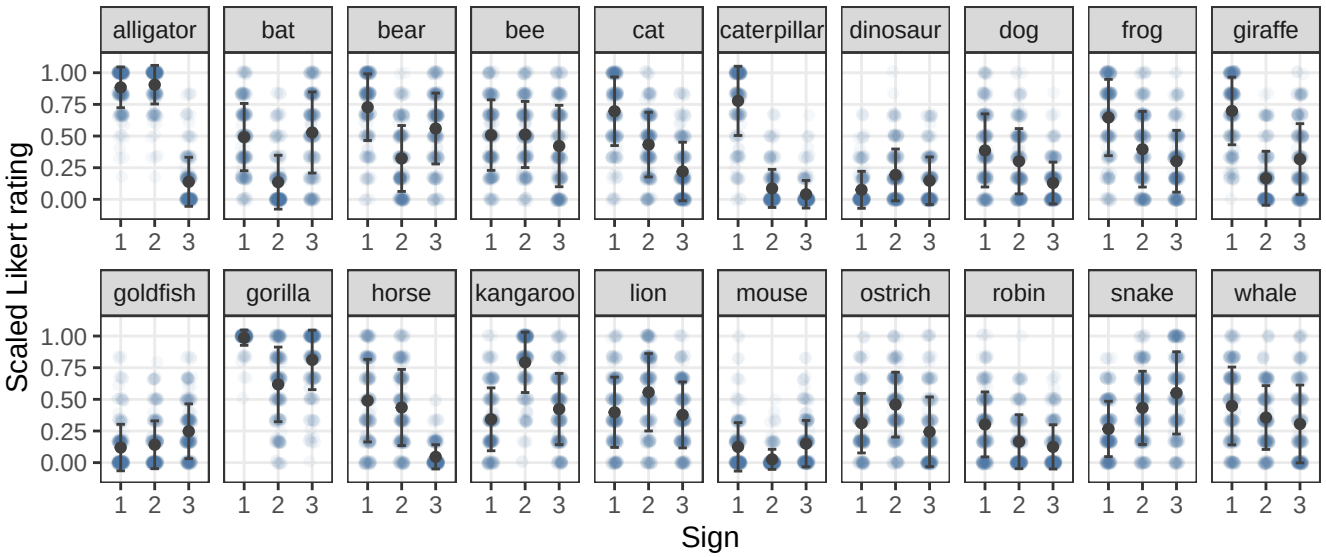

Figure 2: Mean scaled iconicity ratings for each stimulus.

clips. These were presented in randomized order for each participant. Signs were presented one at a time, with the English translation appearing underneath the video. Each item was followed by a screen with the 1-7 Likert scale that participants used to give their rating. All participants rated all 60 signs.

Analysis and Results

The current analysis is a re-analysis of the data from our previous study (Tkachman et al., 2023) in light of the new iconicity scores. The reader is referred to that paper for detailed descriptions of the procedure, data, and analysis of our previous experiment. As a quick recap, the experiment followed a two-alternative forced-choice paradigm, in which 105 participants were shown two signs for an animal drawn from different sign languages. The signs fell into the three categories described above: Target 1 (T1) signs represented the most common cross-linguistic motivation for signs for that animal; T2 signs represented the second most common cross-linguistic motivation, and T3 signs represented the least common cross-linguistic motivation. Two signs were displayed, and participants chose the sign that they thought "best suited" the animal whose English label was presented typographically on the screen. Distractor signs were also included; these were signs depicting the most cross-linguistically common motivation for a different animal, i.e., not the one that was typographically presented (D1). The results of this study showed that, for pairs of signs in which both signs were attested for that meaning, participants reliably chose the more cross-linguistically common sign as "better suited" for the label provided. For pairs including a target and distractor, participants overwhelmingly preferred the target sign.

All 104 (new) participants are included in the present analysis. We treated the Likert ratings as continuous. To derive the iconicity score for each sign, we first scaled the ratings within each participant by subtracting the minimal rating given by the participant across all signs from the original Likert ratings, and then dividing the differences by the range of all ratings given by the same participant. The mean of these scaled ratings across all participants for a sign functions as the iconicity score for that sign. The iconicity score, together with the standard deviation, for each sign is displayed in Figure 2. As can be seen in Figure 2, some signs are rated as very iconic (e.g., ALLIGATOR1 and GORILLA1) while others are rated as not very iconic (e.g., DINOSAUR1 and GOLDFISH1).

In the analysis of the choice data (which sign is a better representation of a specific meaning), we refer to the sign with the more cross-linguistically common motivation as the "expected choice", except in trials including distractors, in which the expected choice was always the target sign (T1, T2, or T3).

In the original model, the dependent variable was the binary categorization response (1 if their response matched the expected option and 0 otherwise), and the only independent variable was Comparison Type (T1 vs. T2, T1 vs. T3, T2 vs. T3, T1 vs. D1, T2 vs. D1, T3 vs. D1). In the current analysis, we included an additional variable—difference in iconicity ratings—in the model. This variable is defined as the difference between the iconicity scores of the two signs in the trial, calculated by subtracting the iconicity score of the non-expected sign from that of the expected sign. For trials involving two targets (i.e., T1 vs. T2, T1 vs. T3, T2 vs. T3), the difference in iconicity rating was therefore calculated by the formula: T1 − T2, T1 − T3, or T2 − T3 (where T1, T2, and T3 here refer to the iconicity rating of the respective signs). For trials that contain distractors (i.e., T1 vs. D1, T2 vs. D1, T3 vs. D1), the difference was calculated as T1 − D1, T2 − D1, or T3 − D1 respectively.

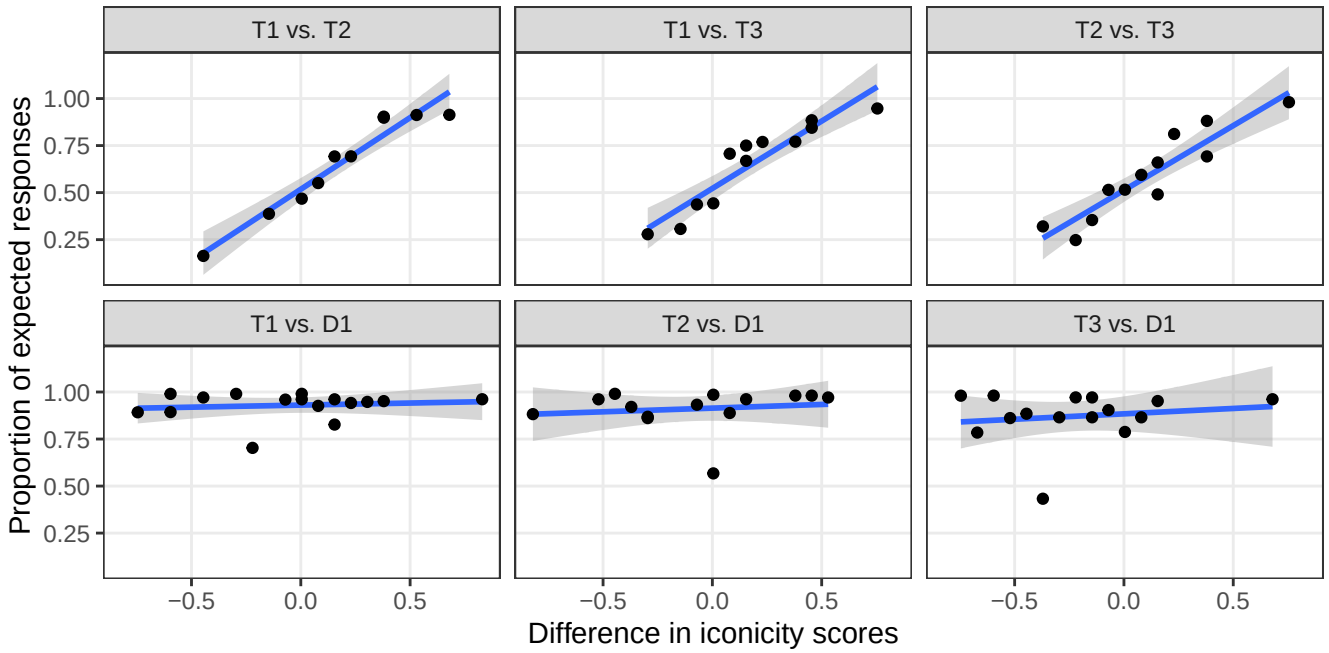

Figure 3: The interaction between comparison type and iconicity difference score.

We modeled the binary categorization responses with a Bayesian mixed-effects logistic regression that had comparison type, iconicity difference score, and their interaction as the fixed effects, as well as by-participant and by-item random intercepts and slopes as the random effects.

The results indicate that, in general, the pairs involving distractors bring out more expected responses than those involving only targets ($\text{mean}_{\text{diff in log}} = 2.79$, 95% CrI [credible interval] $= [2.42, 3.17]$). Crucially, the effect of comparison type is further modulated by difference in iconicity rating, in that if the difference in iconicity between an expected choice and an unexpected choice is greater, participants were more likely to choose the expected sign. The effect of iconicity is not seen in pairs containing a distractor, where expected choices were already close to ceiling ($\text{mean}_{\text{diff in log}} = 4.00$, 95% CrI $= [2.82, 5.18]$) The interaction between comparison type and iconicity difference score is depicted in Figure 3.

Discussion

In our previous study, we found that when people are asked to choose between two iconic signs with the same lexical meaning, they choose a sign that is based on a more frequent cross-linguistic motivation. In this study, we added another factor, iconicity, in order to better understand what makes one sign more preferred for a specific meaning than another sign with the same meaning. We found that iconicity is not a factor when one of the signs has an irrelevant meaning: participants consistently choose a sign with the target meaning over a sign with an irrelevant meaning, regardless of how high or low in iconicity the signs in question are. However, when faced with two signs with the same lexical meaning, not only do participants choose the sign which is based on a more cross-linguistically common underlying motivation, but they are more likely to choose this sign when the iconicity difference between it and its competitor is greater. Higher iconicity in comparison with a competitor, therefore, makes a sign seem even more "suited" to its meaning to sign-naive people.

Recall that all the signs in this study had iconic motivations, that is, their form was motivated by some aspect of their meaning. Where they differed was in how iconic participants perceived them to be. This suggests that some properties of referents are more accessible to perceivers, and that these more accessible properties also impact people's choices about what signs are better suited for certain meanings. Interestingly, these same properties are more frequent cross-linguistically in lexical signs (Tkachman et al., 2023).

What makes a property more accessible to perceivers and more frequent cross-linguistically remains unclear, however. One possibility is that some types of iconicity are more accessible for interpretation (that is, successful guessing) than others. The same referent can be depicted iconically in different ways (see Taub, 2001, for review). Research on young children suggests that the earliest type of iconicity that children become sensitive to is iconicity based on action by or on the referent rather than iconicity depicting some perceptual feature of the referent (Tolar, Lederberg, Gokhale, & Tomasello, 2008). It may be the case that one factor that makes some signs more transparent to our participants (as well as more cross-linguistically common) is the type of iconicity displayed by a given sign. This question needs further exploration; however, even if it is true of iconic signs generally, we are skeptical this was the case for our dataset. The reason for

our skepticism is the fact that all of the referents in our study were animals, and animal signs generally (though not exclusively) tend to be based either on one of the referent animal's features or on its action (see Tkachman, 2022, for a review of some relevant literature). Our previous participants were mostly choosing between different motivations that were exploiting the same iconicity types, and therefore iconicity type is unlikely to be the driving force behind these results.

An alternative explanation is that something about the way humans conceptulize individual concepts could be making some underlying motivations and/or iconic forms easier to interpret for that concept. In fact, in our previous research we suggested that some properties of a category to which the referents belong may be more conceptually salient than others, and therefore be easier to interpret if the sign/gesture form depicting the referent is based on them (Tkachman, Sadlier-Brown, & Hudson Kam, 2021). If true, this could explain other observations in the field, such as the finding that people generally give higher iconicity ratings to signs that have the same iconic instantiation as their gestures for the same referents (Ortega, Schiefner, & Özyürek, 2017; Ortega et al., 2019). If a certain feature of the referent is more conceptually salient than other features, people will be more likely to create gestures based on that feature as well as be more successful in interpreting signs based on that feature. Conceptual salience can potentially explain the results of our previous study as well as the present study: if the feature of the referent is more conceptually salient, then a sign based on this feature will be more transparent and as such perceived as more iconic. What makes a feature more conceptually salient than others is subject to future research, however. And even if conceptual salience does play a role, it is probably only one among other factors. Investigating such factors and disentangling their relative importance continues to be a goal of the current project.

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