Early produced signs are iconic: Evidence from Turkish Sign Language

Beyza Sümer (bsumer@ku.edu.tr)
Koç University, Turkey

Clara Grabitz (c.grabitz@student.ru.nl)
Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen, The Netherlands

Aylin Küntay (akuntay@ku.edu.tr)
Koç University, Turkey

Abstract

Motivated form-meaning mappings are pervasive in sign languages, and iconicity has recently been shown to facilitate sign learning from early on. This study investigated the role of iconicity for language acquisition in Turkish Sign Language (TID). Participants were 43 signing children (aged 10 to 45 months) of deaf parents. Sign production ability was recorded using the adapted version of MacArthur Bates Communicative Developmental Inventory (CDI) consisting of 500 items for TID. Iconicity and familiarity ratings for a subset of 104 signs were available. Our results revealed that the iconicity of a sign was positively correlated with the percentage of children producing a sign and that iconicity significantly predicted the percentage of children producing a sign, independent of familiarity or phonological complexity. Our results are consistent with previous findings on sign language acquisition and provide further support for the facilitating effect of iconic form-meaning mappings in sign learning.

Keywords: Iconicity, language acquisition, sign language

Introduction

Arbitrariness, lack of a motivated link between a linguistic form and its meaning, has long been considered as a design feature of human language (de Saussure, 1915, 1983; Hockett, 1960). However, recent evidence has shown that iconicity, resemblance between form and its referent, is a more pervasive feature of language than previously thought (e.g., Perniss, Thompson, & Vigliocco, 2010; Dingemanse, Blasi, Lupyan, Christiansen, & Monaghan, 2015). For example, ideophones are used to express a wide range of features such as manner of movement, color, shape, size of an object, or emotional and psychological states (e.g., Japanese words 'korokoro' to refer to a light object rolling repeatedly and 'gorogoro' to a heavy object rolling repeatedly) or onomatopoeic words, which use the sound of a word to depict the sound of its referent (e.g., "moo" to refer to a cow) (e.g., Imai & Kita, 2014). Compared to spoken languages, the use of visual-spatial modality makes iconicity a more prominent feature in sign languages (e.g., Taub, 2001). Signers can, for example, use a curved handshape to refer to a cup or use the signing space in front of them to show the location of different objects in relation with each other.

Pervasive existence of iconic forms in languages has intrigued many researchers about its role in language development. Accumulating evidence has shown that iconicity has a facilitating effect for early language development. Imai, Kita, Nagumo, & Okada (2008) reported an advantage for 3-year-old Japanese acquiring children in learning action words when these words are sound-symbolic compared to those which are arbitrarily linked to the sound of the action. In another study, 2.5-year-old children showed a tendency to match the words with rounded vowels to rounded shapes and words with unrounded vowels to pointed shapes (Mauer, Pathman, & Mondloch, 2006). Onomatopoeic words constitute a substantial portion of early acquired vocabulary by German speaking children (Laing, 2014). Also, early acquired words in English and Spanish were rated more iconic than the ones acquired later (Perry, Perlman, & Lupyan, 2015; Massaro & Perlman, 2017).

The potential effects of iconicity have also been explored in the context of sign language acquisition research – although in fewer studies compared to spoken language research. To understand the role of iconic nature of linguistic forms in sign languages, Orlansky & Bonvillian (1984) analyzed whether the first signs learned by signing children were more iconic, but their initial analyses did not find an overrepresentation of such signs in the first 10 words and beyond. In their data, only about a third of words were iconic, which was in line with the overall proportion of iconic signs in American sign Language (ASL). In contrast, Lloyd, Loeding, & Doherty (1985) reanalyzed the data based on a broader definition of iconicity and found an over-representation of iconic signs in early acquired signs. Since then it has become clear that iconicity is a more complex property rather than being a holistic concept, and it is now common to rate the iconicity of signs on a scalar scale of 1 (not at all iconic) to 7 (highly iconic) (e.g., Vinson, Cormier, Denmark, Schembri, & Vigliocco, 2008 for BSL norms). However, iconicity of signs can also differ qualitatively in meaningful ways: for example, signs can represent actions or perceptual qualities of their referents (see Thompson et al., 2011; Ortega, Sümer, & Özyürek, 2016). Under this new view of iconicity, recent studies with signing children have shown that iconicity has a predictive power in early sign learning, i.e., iconic signs are acquired earlier than non-iconic signs (Thompson, Vinson, Woll, & Vigliocco, 2012; Caselli & Pyers, in press). Thompson and colleagues (2012) explored the relationship between iconicity and sign language acquisition using a mixed cross-sectional, longitudinal design on productive and comprehensive vocabulary size of British Sign Language (BSL) acquiring deaf children

of deaf parents administering the MacArthur Bates Communicative Developmental Inventory (CDI). The CDI is a parental report in which parents indicate vocabulary learning by ticking items on a list of words if their child produces or understands them (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994). They collected data from 31 deaf children aged between 8 and 30 months and found that iconicity facilitates sign learning from early development on, but particularly in children older than 21 months. They argue that the advantage seen in older children could be due to more cognitive capacity or more environmental experience which children can use to understand and establish such iconic links between meaning and form.

It has also been proposed that other properties of a sign may be as or even more important than iconicity such as lexical frequency (i.e., familiarity), neighborhood density (i.e., the number of lexical items that are phonologically related to a target), or phonological complexity (Caselli & Pyers, in press; Thompson et al., 2012). Phonological complexity in sign language is based on motoric subunits and seems to be a crucial factor because children learning a sign language show phonological reductions and substitutions of features that are marked less – similar to children learning a spoken language (e.g., Meier et al., 2008). To what extent these factors are influential on early sign learning is also controversial since Thompson et al. (2012)'s results indicate iconicity to be a more powerful predictor than other factors such as familiarity or phonological complexity, while Caselli and Pyers (in press) argue that neighborhood density and lexical frequency (familiarity) are also as strong contributors as iconicity in early sign development.

Studies with signing and speaking children provide converging evidence on the facilitating role of iconic form-meaning mappings in early lexical development regardless of the language modality. Investigating the effects of iconicity in sign language acquisition provides further evidence for this "modality-free" role of iconic forms in this domain of language development and contributes to our understanding on to what extent general principles of conceptual development influence the language development in signing children – a less studied population compared to speaking children.

The Present Study

The aim of the current study was to add to the growing literature on the role of iconicity in sign language acquisition by studying children acquiring TID, which has been studied less than many Western sign languages such as ASL or BSL. Analyzing data from other sign languages is crucial, because conflicting views on the role of iconicity in sign language acquisition still exist (e.g. Thompson et al., 2011). Based on Thompson et al. (2012) and Caselli & Pyers' (in press) findings, we assumed that the visual-spatial modality of sign language, which is rich in iconic form-meaning mappings, would modulate language acquisition and that iconicity could present a potential advantage in early language development for TID acquiring children. We hypothesized that the iconicity of a sign would be correlated with the percentage of children producing the sign. We further expected iconicity to be a significant predictor of the percentage of children producing a sign, even if after controlling for familiarity and sign complexity.

Method

Design

The experiment was realized with a correlational design. Simultaneous multiple regression was used to test whether different sign characteristics (iconicity, familiarity and phonological complexity) were good predictors for the percentage of children producing a sign.

Participants

Data were collected for 27 deaf children of deaf parents and 16 hearing children of deaf parents (i.e., CODAs), thus for a total of 43 children (female 28) born to deaf families and exposed to TID from birth. Where possible, parents participated in data collection at two separate time points, with a 3-month interval, thus increasing our data set to a total of 57. Although CDI typically tracks vocabulary development in children between 8-36 months of age, the age of the children in the current study ranges between 10-45 months (M = 25.98, SD = 10.23) to increase sample size. The majority of children were from families with a middle or upper socio economic status, meaning that at least one parent works in a paid job and completed high-school education.

Procedure

Data were elicited from a version of the MacArthur Bates Communicative Developmental Inventory (CDI) adapted for TID. In this version, three source tests were taken into consideration to account for modality and cultural specific issues: ASL CDI (Anderson & Reilly, 2002), BSL CDI (Woolfe, Herman, Roy, & Woll, 2009) and Turkish CDI (TIGE, Aksu-Koç, Küntay, Acarlar, Maviş, Sofu, Topbaş, & Turan, 2009). As a result, TID CDI consists of 500 items grouped into 18 categories such as "animals", "toys" and "actions".

Although previous CDIs, both for sign and spoken languages, were administered in a pen-and-paper format, considering low reading abilities of deaf people (e.g., Bloomquist Traxler, 2000), we presented TID CDI in a web-based format where parents themselves logged onto the system to see videos of signs one after each other and decided whether their children produced the sign in the video. This procedure was preceded by a training session in which they saw instruction videos in TID and asked any clarification questions to a deaf assistant, who was also online during entire training session. Only sign production data was collected since a small pilot study with a group of deaf parents showed that it was often confusing to differentiate comprehension versus production of a sign for them. They also expressed that they were less sure about their answers regarding

comprehension since they cannot see comprehension but only production of the signs.

As part of another study (Taşçı & Sumer, in prep), 4 deaf signers of TID (M_{age} = 32.3) were shown a total of 328 signs on a computer screen and asked how iconic they think these signs are. Here, the iconicity was defined as the similarity between the linguistic form (i.e., sign) and the entity that it refers to, including both the perceptual and/or action-based properties. In another session, 5 deaf signers (M_{age} = 33.4), were asked how familiar they think these signs are. Both iconicity and familiarity ratings were on a scale of 1 (*not at all iconic/familiar*) to 7 (*highly iconic/familiar*) (e.g. see Vinson et al., 2008 for norms in BSL for comparison). We additionally included phonological complexity ratings following Mann, Marshall, Mason, & Morgan (2010), in which three main phonological parameters of signs (i.e., handshape, location, movement) were assigned a complexity value. For example, unmarked handshapes in TID, as determined by Kubus (2008), were rated less complex than other handshapes.

Results

We excluded data points with unrealistic productive sign scores aged 10 to 20 months, if they were outside the Mean plus Standard Deviation found for ASL norms (Anderson & Reilly, 2002) for the child's age range. These sign scores can be attributed to a misunderstanding during data collection. Exceptionally high sign scores were not excluded for children aged older than 20 months, as high variability is a key component of language acquisition. Thus, we included a total of 51 data points in our analyses. The productive sign score for the subsample of 104 signs was (M = 51.27, SD = 32) (Table 1).

Table 1. General descriptive statistics after excluding outliers (N = 51)

Age	Total Productive sign score	Subset Productive sign score
10 - 45	1 - 500	0 - 104
M = 27.45	M = 215.49	M = 51.27
SD = 9.74	SD = 154.56	SD = 32

N = Sample size, M = Mean, SD = Standard deviation

Each sign was on average produced by 44% of children (M = 0.44, SD = 0.18). Spearman's correlation between age and subset productive sign score was significant (r_s = .54, p < .001).

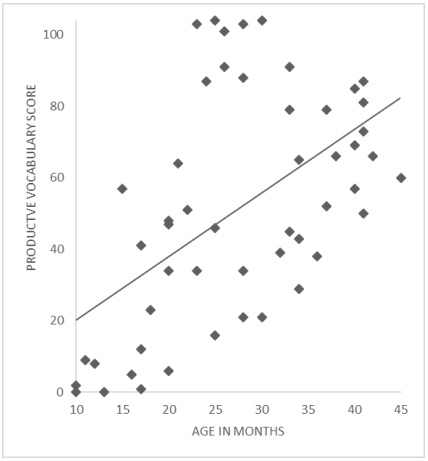

Figure 1. Spearman's correlation between subset productive sign score and age in months. Linear trend lines included.

Iconicity, familiarity and complexity scores of 104 signs were available and used for further analyses (Table 2).

Table 2. Sign ratings and descriptive statistics for the subset of 104 signs

Iconicity	Familiarity	Complexity	Mean Age of Production	PerProd
1 - 7 M = 5.15 SD = 1.89	2 - 7 M = 6.16 SD = .91	0 - 2 M = .64 SD = .67	4 – 27 M = 15.13 SD = 5.84	.11 - .84 M = .44 SD = .18

M = Mean, SD = Standard deviation, Mean Age of Production = mean age of children capable of producing a sign, PerProd = percent of children capable of producing a sign

Spearman's correlations were carried out to clarify the relationship between the main variables in the study (Table 3). Mean Age of Production and Percentage Producing were highly positively correlated and therefore only percentage of production was used for further regression analyses. Iconicity r_s= .38, p < .001 and familiarity ratings r_s= .32, p = .001 were both significantly positively correlated with Mean Age of Production and Percentage Producing. However, iconicity and familiarity ratings were not correlated. Phonological complexity was not correlated with Mean Age of Production and Percentage Producing and was also unrelated to iconicity and familiarity ratings.

Table 3. Spearman's correlations between the main variables in the study

	PerProd	Icon	Fam	Complexity
Mean Age of Production	1**	.39**	.32**	-.13
Percentage Producing		.38**	.32**	-.13
Iconicity			.13	-.18
Familiarity				-.03
Complexity				

**p ≤ .005, PerProd = Percentage of children capable of producing a sign, Icon= Iconicity, Fam = Familiarity

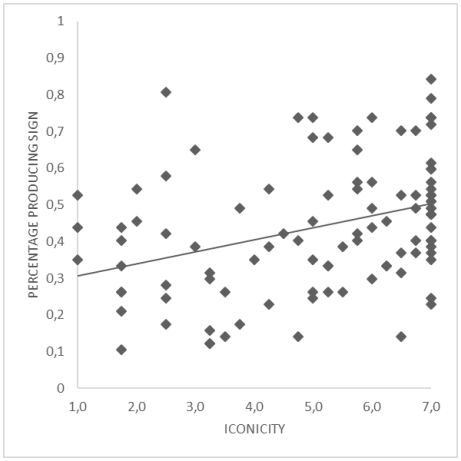

Figure 2. Spearman's correlation between iconicity ratings and percentage of children producing a sign. Linear trend line included. r_s= .38, p < .001.

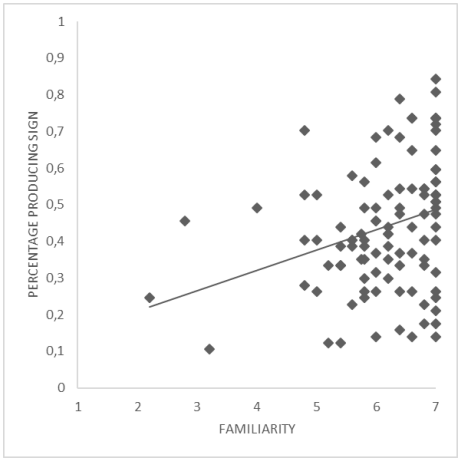

Figure 3. Spearman's correlation between familiarity ratings and percentage of children producing a sign. Linear trend line included. r_s= .32, p = .001.

The data were entered into simultaneous multiple regression analysis, using the percentage of children producing a sign as dependent variable and iconicity, familiarity and complexity as predictors. The results for the model indicate that the predictors explained 17% R^2= .17, $F(3,100) = 7.84$, $p < .001$. Both iconicity $\beta = .31$, $t(100) = 3.38$, $p = .001$ and familiarity $\beta = .25$, $t(100) = 2.78$, $p = .006$ significantly predicted the percentage of children producing a sign. Phonological complexity was not a significant predictor. Adjusted R Squared values were used in the analysis.

Discussion and Conclusion

We investigated the role of iconicity in the acquisition of Turkish Sign Language (TID) by signing children of deaf parents and found that the iconicity of a sign was positively correlated with the percentage of children producing a sign. In addition to iconicity, familiarity, but not phonological complexity, seems to be influential in early sign learning. We thus provide further evidence regarding the facilitating role of iconicity in early sign learning by signing children.

Our results converge with what previous studies with signing children have found so far (Thompson et al., 2012; Caselli & Pyers, in press). There is robust evidence showing that early acquired signs are iconic, which suggests that resemblance between form and meaning in sign languages bootstraps word learning in sign languages. Moreover, analyzing parental input to BSL signing children aged between 25-51 months, Perniss, Lu, Morgan, & Vigliocco (2017) suggest that deaf parents exploit iconicity while communicating with their children. These studies also show that iconicity seems to be more advantageous for sign language acquiring children when they are at around 30-months of age – although this age group is called "older" in Thompson et al. (2012) and "younger" in Caselli & Pyers (in press). This seems to be related to increasing cognitive skills or more experience with environment that enables establishing the link between linguistic form and meaning (Thompson et al., 2012).

Further evidence from spoken languages, which are less rich in iconic forms than sign languages (Taub, 2001), has been presented about the facilitating role of iconicity, as well (e.g., Imai & Kita, 2014; Imai et al., 2008; Laing, 2014; Perry et al., 2015; Massaro & Perlman, 2017). The effect of iconicity in early word acquisition in spoken languages seems to be more prominent earlier compared to what studies with signing children report. Studying expressive and receptive vocabulary development in the first four years of English acquiring children (6-47 months of age), Massaro and Perlman (2017) show that iconicity is more prevalent early in acquisition and decreases with increasing age and vocabulary size. There might be a difference in the role of iconicity throughout development due to different modalities of sign and spoken languages: sign languages are rich in iconic forms and signing children are more likely to encounter iconic forms – not only at the lexical level but also at the level of morphology (e.g., classifiers) and syntax (e.g., expressing spatial relations in signing space) than speaking children whose lexicon gets enriched with less iconic words (more arbitrary forms) as they get older. Therefore, iconicity seems to help children in their early word learning, but its role might change as children acquiring languages in different modalities advance in their language development.

Our results regarding other factors than iconicity such as familiarity and phonological complexity are partially in line with Thompson et al. (2012), who found iconicity to be a stronger predictor of early sign acquisition than others. The current study, on the other hand, reveals the role of familiarity as important as iconicity, which is in line with Caselli & Pyers (in press). The findings regarding the role of phonological complexity do not suggest that it predicts early sign learning – as opposed to Caselli & Pyers (in press). The difference might come from different definition of complexity since Caselli & Pyers (in press) focused on neighborhood density (the number of lexical items that are phonologically related to a target) rather than a complexity rating system as used in the current study. Thompson et al. (2012) also

observed an effect of phonological complexity, but this effect was restricted to younger children (11-20 months of age) only while Caselli & Pyers (in press) found the neighborhood density effect across all age groups (8-35 months of age). This might be still a result of different approaches taken to the analysis of phonological complexity in different studies.

However, one needs to be careful when interpreting our findings as the sample size was small and we had to exclude multiple outliers for the main analyses. Furthermore, only production scores were collected. Since comprehension scores are less prone to phonological and motor constraints, drawing conclusions from production scores only may underestimate the role of iconicity, especially for younger children who produce substitution errors while producing signs (e.g., Lu, Jones, & Morgan, 2016).

It is also important to note that iconicity and familiarity ratings were mostly available for nouns which could have further skewed our sample as some of the first words were "come" or "kiss". Perry et al (2015)'s results from English and Spanish suggest that adjectives are rated as more iconic than nouns and function words, and verbs as more iconic than nouns and function words in English. Perniss et al. (2017), however, found that signs for objects and actions are rated more iconic than those for properties (e.g., blue, fast). This might be the result of modality difference between sign and spoken languages and underlines the importance of including different lexical categories in such an analysis.

Additionally, the current study is clearly limited by the correlational approach taken. With sufficient resources a Bayesian modelling approach similar to Thompson et al. (2012) or a mixed-effect logistic regression modelling approach will be more powerful as one can simultaneously account for child-specific and item-specific variability while controlling for factors such as familiarity or phonological complexity. The current data set could be used as a basis for further analyses, but it will also be beneficial to collect iconicity and familiarity ratings for more signs, in particular for signs that are action related and represent a wider range of familiarity ratings.

Finally, the present study is clearly limited by the use of parental reports – spontaneous production sessions that target sign and speech output and/or recordings of the children that are scored will be useful to further qualify results, particularly in regard to underlying mechanisms and driving forces. Innovative approaches towards testing are needed, such as Perniss et al. (2017) who analyzed child directed signing using only the parents in an experimental setting and showed that child-directed signing exploits iconicity, especially when referents are not present. Such studies will further qualify the input that signing children receive and might be decisive in determining the real importance of iconicity for language acquisition.

Our study represents a further step on the way exploring iconicity in relation to sign language acquisition. While we do not agree with the notion that only cognitive development drives language acquisition based on our results, iconicity cannot explain all aspects of early sign language acquisition. Acquisition of these signs is likely to be driven by contextual factors such as use of frequency (with both adults and children) or neighborhood density (Caselli & Pyers, in press).

In summary, language acquisition is likely to be facilitated by iconicity. Considering the potential benefit of meaningfully motivated form-meaning for language acquisition in general, both iconicity and arbitrariness should be re-evaluated as general properties of a language (Perniss et al., 2010), although more studies are needed to further support this claim and its relevance for all languages.

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