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Patterned iconicity in sign language lexicons

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Iconicity is an acknowledged property of both gesture and sign language. In contrast to the familiar definition of iconicity as a correspondence between individual forms and their referents, we explore iconicity as a shared property among groups of signs, in what we call *patterned iconicity*. In this paper, we focus on iconic strategies used by hearing silent gesturers and by signers of three unrelated sign languages in an elicitation task featuring pictures of hand-held manufactured tools. As in previous gesture literature, we find that silent gesturers largely prefer a *handling* strategy, though some use an *instrument* strategy, in which the handshape represents the shape of the tool. There are additional differences in use of handling and instrument strategies for hand-held tools across the different sign languages, suggesting typological differences in iconic patterning. Iconic patterning in each of the three sign languages demonstrates how gestural iconic resources are organized in the grammars of sign languages.

Keywords: iconicity, sign language typology, new sign languages, established sign languages, silent gesture

Introduction

In this paper we discuss a shared iconic patterning for lexical signs for hand-held man-made artifacts ("tools") in three sign languages: the *handling/instrument pattern*. In American Sign Language (ASL), one of the sign languages we discuss here, the signs for toothbrush and comb have different handshapes, different movements, and different locations on the body, but they both use the fingers to represent iconically the dimensional properties of the object along with movement depicting a typical human action with that object. In TOOTHBRUSH, the index finger is extended while the hand moves sideways back-and-forth near the mouth in the action of brushing one's teeth. In COMB, the fingers are extended and bent while the hand moves downward in a repeating movement near the

Gesture 13:3 (2013), **287–308**. DOI 10.1075/gest.13.3.03pad
ISSN 1568–1475 / E-ISSN 1569–9773

head, following the typical action of combing one's hair. These signs are examples of what we call the *instrument* type. A number of other ASL signs for tools use the *handling* type. In these forms, the handshape shows how the object is held along with movement depicting a typical action with that object. The handshape in HAMMER is a grasping type, as if holding a hammer, along with characteristic downward repeating movement in neutral space in front of the signer's body. LIPSTICK also has a handling handshape, but as if holding a small cylinder, with a small back and forth movement near the lips.

To our knowledge, using the terms *handling* and *instrument* contrastively to characterize lexical signs has not been proposed in the sign language literature, though similar terminology has been used to describe polymorphemic predicates, or classifier structures, in sign languages (Boyes-Braem, 1981; Liddell, 2003; Liddell & Johnson, 1989; McDonald, 1982; Schick, 1990; Supalla, 1986). In the work on sign language classifiers, which often deal with space and movement, handling and instrument are collapsed as a single category where the hands represent how agents handle and manipulate various objects. Supalla (1986) refers to these cases as "instrumental hand classifiers", which he categorizes as a type of "instrument classifiers". "Instrument classifiers" also include cases where the handshape represents the manipulated object, which Supalla calls "tool classifiers". Here we distinguish between handling and instrument as distinct strategies in a lexicon, where the handling strategy represents how the object is held or grasped with human hands and the instrument strategy additionally represents the dimensions of the object (Figure 1a, b). Furthermore, we contrast *instrument* with another strategy, *object,* used in the sign language literature to refer to "object-classifiers" (Brentari et al., 2012; Hunsicker & Goldin-Meadow, 2013) (Figure 1b, c). We reserve use of the term object for when the hands represent the shape of the object but human action is *not* represented, as in the ASL sign for TREE, but it is also used in ASL as a classifier in the description of spatial configurations, as in Figure 1c.

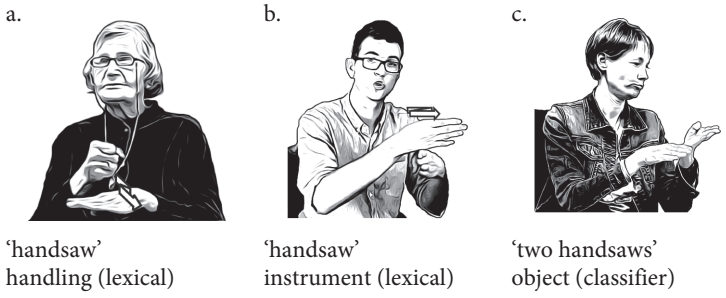


Figure 1. ASL signers' use of the *handling*, *instrument* and *object* strategies

In the gesture literature, handling forms have variously been called "pantomime" (Goodglass & Kaplan, 1963) or "symbolic object" because the hands manipulate an imagined object (Overton & Jackson, 1973). When hearing non-signing adults are asked to silently gesture how they might indicate a common object such as a toothbrush, a comb, or a cup, they typically show how they handle or grasp the object. Young children, however, tend to use their hands to show a dimensional property of the object when gesturing an action involving the object (Boyatzis & Watson, 1993; O'Reilly, 1995; Overton & Jackson, 1973). Overton and Jackson describe younger children's preference for what they call "body-part-as-object" as indicative of an inability to imagine holding or grasping an object. Instead, their handshape represents the object. For toothbrush, their index finger mimics the length of a toothbrush as they gesture brushing their teeth. As children grow older, at around age 8–9 years, they acquire cognitive flexibility and their responses become more like those of adults. In these previous gesture studies, instrument and object forms are often collapsed together under the same coding. Here again we purposely separate the two. As shown in Figure 2, we find handling, instrument and object forms among nonsigners' *silent gestures*, which are gestures produced without accompanying speech. The three strategies in Figure 2 therefore mirror the three in Figure 1. Note that while object forms are used often for classifiers in ASL, gesturers produce object forms for naming (Figure 1c, 2c).

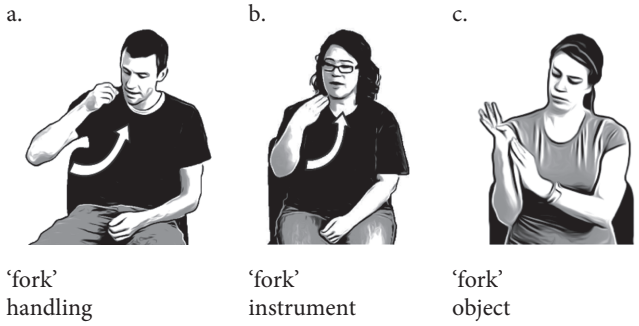


Figure 2. American hearing gesturers' use of *handling*, *instrument* and *object* strategies

We propose that in sign languages handling and instrument forms are related as an example of *patterned iconicity*, where repeated use of an iconic strategy serves to identify members of a lexical group. As we demonstrate here, from elicitation studies carried out in ASL, ABSL, and NZSL, this particular handling/instrument pattern is often used for manufactured, hand-held artifacts, which we call tools throughout. One of the three sign languages we study is Al-Sayyid Bedouin Sign Language (ABSL), a new sign language that emerged over the last 80 years in a Bedouin village. Though the language is new, signers strongly exhibit a preference

for instrument forms over handling forms with respect to nouns for hand-held tools. The third sign language in our study was New Zealand Sign Language (NZSL), an established sign language unrelated to either ASL or ABSL. NZSL signers' responses show they too use the handling/instrument pattern, but instead exhibit a preference for handling forms over instrument forms for the same group of tools. The similarities and differences across three sign languages in use of this particular iconic patterning provide a novel means of carrying out typological comparisons in sign languages.

We argue that the handling/instrument pattern in sign languages draws from broad, expressive abilities of human beings using visual-gestural resources. These abilities involve using the body and the hands to depict and represent objects in the human environment. Using the same elicitation task, we asked American and Israeli Bedouin hearing non-signers to spontaneously create silent gestures. Our results replicate earlier findings showing a preference for handling gestures in hearing adults for hand-held objects (Goodglass & Kaplan, 1963; O'Reilly, 1995). Here we demonstrate that the handling preference holds across at least two groups of hearing non-signers who speak unrelated languages and live in different cultures. Nevertheless, hearing non-signers also produce instrument forms. The handling and instrument forms we identify here are produced by non-signers and signers alike, demonstrating that iconicity in gesture persists in sign language. These iconic forms are not distributed freely in sign languages; they are adopted as part of a larger linguistic pattern.

A different notion of iconicity in sign languages

There are two principal ways that iconicity has been discussed in the sign language literature (Perniss et al., 2010): 1) the notion of an *iconic sign*, or a form-meaning mapping between an individual sign and its referent (Klima & Bellugi, 1979; Pizzuto & Volterra, 2000), and 2) as *iconic resources*, where combinations of handshapes, movements, and locations are combined to convey meaning (Meir, 2010; Taub, 2001). In both senses of iconicity, the emphasis is on how the individual sign appears or looks like its referent, or can metaphorically stand for a related concept. As Taub (2001) explains, the sign DIPLOMA combines the two hands, both using round handshapes extending away from one another to show the cylindrical shape of a rolled paper diploma. The representation of a cylindrical object is used to express the abstract concept of a diploma. The same combination of iconic resources can be altered in size and dimension to refer to different kinds of cylinders: water pipes, batons, or a rolled-up poster.

Here, we introduce a third notion of iconicity, *patterned iconicity*, where groups of signs combine *iconic strategies* in order to convey semantic class. In this paper, we discuss at length the handling/instrument pattern in order to illustrate both how iconic strategies that are present in gesture are used in sign languages, and how one or more strategies form a pattern. In signs exhibiting the handling/instrument pattern, the movement of the sign conveys a characteristic human action used with the referent, a manufactured tool. Within this pattern, the handshapes vary, either to reflect handling or instrument. The two strategies are distinct from another iconic strategy we mentioned earlier, object, where there is no characteristic human action, but the sign shows the shape and dimension of an object. Signs with the object strategy have movement, but it is not characteristically human, for example the ASL signs TREE or AIRPLANE. These signs have small repeating movements, but they are not representative of how humans manipulate or grasp objects in the world.

Our notion of patterned iconicity rests on a key observation about iconicity in sign languages, that the body of the signer is not simply a vessel for the arms and hands, or one of possible locations for individual signs, but is itself absolutely essential in meaning. The body is both an articulator and a semiotic resource. Our observation follows work by our colleagues about the essential role of the body in sign languages, necessitating a shift from studying hands and bodies separately, to linking the two together. Meir et al. (2007) discuss the notion of "body as subject", where the body represents the lexical subject in a clause. This formulation of the body has a number of consequences for linguistic description of sign languages. As they explain, the iconic resource of the body provides an account for the organization of sign language verb morphology. The body of the signer represents the subject ('I drink') where the signer puts a cup to her own mouth, or first person, or the speaker ('he gives me'), where the movement of giving is directed toward the signer's body. Competition or overlap between subject and first person, such as 'I give him', is resolved by compartmentalizing verbs into distinct classes, each with different semantic properties (Meir et al., 2013; Padden et al., 2010). When we speak of patterned iconicity as a set of strategies, we acknowledge that iconicity is not a single, monolithic property of signs and their referents, but is exploited and differently expressed in phonology, morphology, the lexicon, and other levels of linguistic structure. Patterned iconicity is a resource for the lexicon in which signers use iconic strategies to convey semantic category information.

In our investigation of patterned iconicity in sign language lexicons, we asked signers of three different sign languages to name pictures of hand-held tools. In order to compare their responses to observations about similar forms in the gesture literature, we asked two groups of non-signers to provide silent gestures for the same set of pictures. Our results suggest that signers exhibit patterns unlike what

we see among non-signers. Furthermore, each sign language exhibits a handling/instrument preference, revealing a potential measure of typological variation in sign languages with respect to iconic signs, even as they draw from the same common gestural roots.

Method

Participants

Two groups of hearing non-signers were recruited: American hearing adults from the undergraduate population at University of California, San Diego (n=19, 11 female) and Bedouin hearing adults (n=11, 0 female[1]) from a village near Al-Sayyid (where ABSL is used) in southern Israel. None of the American participants have taken sign language classes, and all are monolingual English speakers. None of the Bedouin men we tested have deaf relatives or reported that they interacted with deaf signers. As is common in the country, the Bedouin men are bilingual Arabic-Hebrew speakers.

Nine ABSL signers (5 female) from 6 different families were recruited. ABSL, now about 80 years old, is one of a number of new sign languages that are now being studied as examples of de novo language creation (Meir et al., 2010). One participant is a second-generation signer, and the remaining are third-generation signers. One participant is a hearing brother with deaf siblings. All other participants are deaf. All members of the first generation of signers are now deceased, and the remaining second- and third-generation signers continue to use the language in the village.

Signers of two different established sign languages, ASL (n=12, 9 female), all native signers (having one or two deaf parents), and NZSL (n=7, 4 female), 1 native signer, were recruited and tested in their respective countries, the U.S. and New Zealand.[2] Both languages have large populations of users; ASL is estimated to have about 300,000–500,000 primary users, and is about 7 generations removed from its origins in the early nineteenth century (Lane, 1984; Lane et al., 2011). New Zealand Sign Language has about 4,000–7,000 primary users, and is descended from British Sign Language, which is purported to be older than ASL (McKee & Kennedy, 2005).

Materials

We developed an elicitation protocol using slides, each displaying a commonly used hand-held tool. We chose items where it is easy to recognize in both gesturers

and signers either handling or instrument forms, or use of another strategy such as tracing. Items such as cup, used for other studies, were excluded from our set for the reason that the handshapes for handling or instrument responses are difficult to differentiate. For Americans, holding a cup and moving it toward the mouth (handling) is similar or indistinguishable from cupping the hand to show the shape of a cup as the hand moves to the mouth (instrument). The final 24 stimuli[3] that were chosen for elicitation and analysis were: 4 clothing items (hat, jacket, gloves, pants), 3 utensils (fork, spoon, knife), 9 hand tools (broom, vacuum, scissors, rake, hand saw, screwdriver, paintbrush, hammer, mop), 4 grooming tools (toothbrush, comb, hairbrush, hairdryer), 3 cosmetic products (mascara, nail polish, lipstick), and 1 other handheld item (cellphone). Our results confirmed that this group of items can elicit the handling/instrument contrast. For none of the items did all respondents provide only handling or only instrument; we found both handling and instrument forms among the responses for each of the 24 items in this set.

Procedure

Pictures for the items were assembled into a slide show on a laptop with each object on a separate slide. We varied the number of the same object in a single slide, ranging from one to four objects per slide (for example, we had one pair of scissors, four toothbrushes, and two hand-saws on their respective slides; Figure 3); we used varying numbers to encourage naming objects without needing to provide a long description of how they are used. We asked hearing non-signing participants to "identify the object is using only your hands without speaking, and identify how many there are." Signers were asked to produce signs for the objects in their own sign languages. All participants were given the opportunity to gain feedback before beginning the elicitation with 4 practice items, each on its own slide: umbrella, wrench, shovel, shirt. During the practice items, the experimenter explained to participants that they should avoid pointing to their own clothes (e.g., shirt), and use gestures or signs instead, to stay seated during the elicitation (e.g., standing up to show shovel), and to not provide long narratives about the object (e.g., umbrella and using it in the rain). Once they began the elicitation, they could proceed at their own pace and were asked to direct their responses to another person, either a hearing tester for gesturers, or another signer in their own sign language who sat next to the camera.

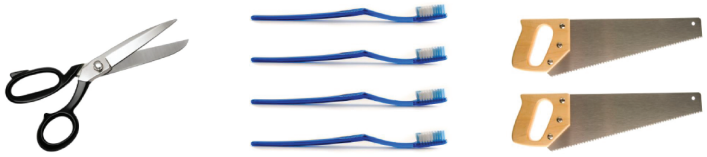


Figure 3. Examples of elicitation slides

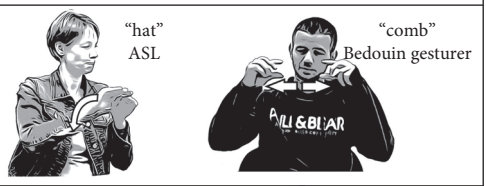
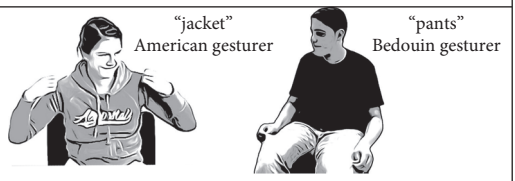
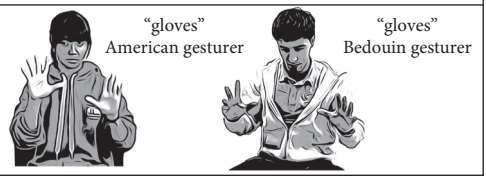
Coding

All responses were coded according to iconic strategies discussed below, using ELAN annotation software developed at Max Planck Institute (Crasborn & Sloetjes, 2008). For this study, we analyzed the forms produced by the dominant hand only.[4] Table 1 lists the types of responses that were produced by participants, with their criteria and examples. The most common strategies elicited across groups were handling and instrument, which we call 'major types.' Other types of responses appeared in our data, but less often, called the 'minor types' (Table 2) and they are: 1) *object*, when the hand represents the shape and dimensions of an object but there is no human action movement with them; 2) *tracing*, showing the outline of an object; 3) *touch*, when the hand touches a location on the part of the body where the object is commonly found or used; 4) *body part*, showing the body part where the object can be found, such as holding up a hand to refer to gloves, or pursing the lips to refer to lipstick. Responses specific to a sign language such as fingerspelling or arbitrary, non-transparent signs were coded as such. Indexic points to objects in the room were coded, but not included in this analysis. Any part of a response that was inadvertently extended outside the video frame was listed as "uncodable" and not included.

Table 1. Examples of coding for handling and instrument strategies

Major Types	
Handling: Grasping an imaginary object while performing a canonical action	 "comb" NZSL  "broom" Bedouin gesturer
Instrument: Depicting features of an object while performing a canonical action	 "comb" ABSL  "paint" American gesturer

Table 2. Examples of coding for object, tracing, touch and body part strategies

Major Types	
Object: Depicting features of the object with the hands with no action	
Tracing: Depicting an outline of an object's shape or dimensions	
Touch: Touching on or near the body where the object is typically found	
Body Part: Holding up a part of the body where an object is typically found	

The coded data were analyzed to determine the percent of items that elicited a particular strategy for each individual participant. Because the participants were not instructed to limit their response to a single gesture or sign, there were instances when they produced multiple responses, with some participants occasionally producing as many as three different strategies in one response. Analyzing the percent of items that elicited a particular strategy allows us to avoid giving more weight to items eliciting multiple strategies than those eliciting a single strategy. Note that because participants can provide more than one response, it was possible for the sum of these type percentages to be greater than 100% for a participant. To describe the patterns seen within a particular group, we report the mean average of percentages by strategy.

Next, we examined consistency among the participants within a group for using the same strategy for each object. We defined consistency or agreement as when >70% of the participants used the same strategy for a particular item, regardless of what strategy it may have been. Finally, we identified those items for which there was 100% agreement on strategy within each group. For this paper, we did not compare whether signers or gesturers had the *same sign* because, as we

discuss below, their signs were sometimes different, but they had the *same strategy*. These measures of agreement allowed us to identify preferential patterning across signers and gesturers.

A second coder independently coded strategies of a randomly selected gesturer or signer from each group of participants. There was 95% agreement between the first and second coders. Coding decisions on the remaining 5% were resolved in consultation with researchers involved in the project.

Results

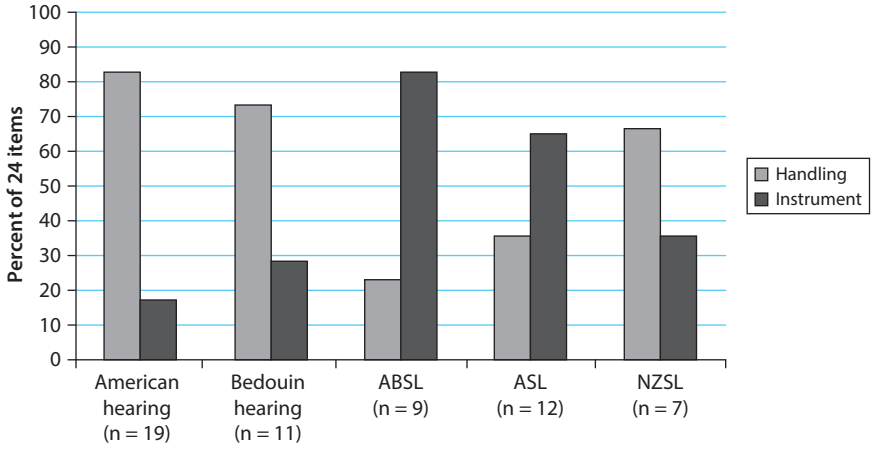


Figure 4. Mean percent of responses with handling and instrument forms in all five groups of participants

Table 3. Summary of the mean percent responses using handling and instrument types; both standard deviation (S.D.) and standard error (S.E.) are reported

	ABSL	ASL	NZSL	Bedouin hearing gesturers	American hearing gesturers
Number of participants	n=9	n=12	n=7	n=11	n=19
Mean percent handling for 24 objects	**23%** (S.E.=2.8%) (S.D.=8.4%)	**35%** (S.E.=1.7%) (S.D.=5.8%)	**67%** (S.E.=3.0%) (S.D.=8.0%)	**73%** (S.E.=2.9%) (S.D.=9.6%)	**83%** (S.E.=3.7%) (S.D.=16.0%)
Mean percent instrument for 24 objects	**82%** (S.E.=2.9%) (S.D.=8.8%)	**65%** (S.E.=1.4%) (S.D.=10.3%)	**36%** (S.E.=2.2%) (S.D.=11.1%)	**28%** (S.E.=3.7%) (S.D.=11.7%)	**17%** (S.E.=2.9%) (S.D.=13.5%)

Preferential patterning in hearing non-signing gesturers

Despite speaking different languages and living in different regions of the world, American and Bedouin non-signing gesturers have similar patterns with respect to how they gesture silently about hand-held tools: both groups prefer the handling strategy for the set of items in this elicitation (Figure 4, Table 3). On average, Bedouin hearing participants gave a handling response for 73% of the items. The American hearing participants showed a similar but slightly stronger pattern, preferring the handling type for 82% of their responses. Only one American participant showed a different pattern; he produced handling forms for only 25% of the items, instead used instrument forms in 58% of the items, and tracing for the remaining 17%. All hearing non-signers in the two groups, except for one American, produced at least one type that is not handling, demonstrating that while the handling type is strongly preferred, it is not an exclusive option for silent gesture. Generally, our results with hearing non-signers are compatible with previous studies describing hearing adults' use of gesture in response to similar kinds of objects (Goodglass & Kaplan, 1963; O'Reilly, 1995).[5]

By group, on average, 28% of the items elicited instrument forms in the Bedouins' responses, and 17% among the Americans'. Though both groups strongly preferred handling, the next most common response across groups and within groups is the instrument strategy. A few American responses included object forms, where they depicted the shape or dimensions of an item without a human action, on average, in less than 1% of the items, and no such cases were attested among the Bedouins. Very few of the hearing participant responses used a tracing strategy, with tracing comprising only 1% of items among Bedouins, 2% among Americans.

Certain items were more likely to elicit instrument forms than others. One hundred percent (100%) of the Bedouin participants produced an instrument type for scissors, compared to 74% of the American participants. For cellphone, 82% of Bedouin and 63% of American participants produced an instrument form (Figure 5). A higher use of instrument forms for those items may be due to the fact that gestures for scissors and cellphone are often used as emblems with or without speech, as in when speakers say, "I'll call you" or play rock-paper-scissors.

Additional items that elicited high rates of instrument forms were gloves (64% Bedouins, 53% Americans), nail polish (55% Bedouins, 21% Americans), hat (45% Bedouins, 26% Americans), mascara (46% Bedouins, 25% Americans), handsaw (45% Bedouins, 16% Americans), lipstick (37% Bedouins, 11% Americans), and knife (37% Bedouins, 11% Americans).

If the hearing participants were not using either handling or instrument, they varied widely in use of other strategies. Touch was the preferred form for pants in 64% of the Bedouin participants, compared to 27% handling and 18% instrument.

'cellphone' handling

'cellphone' instrument

Figure 5. Examples of handling and instrument forms of cell phone in American gesturers

Among American non-signers, handling was still the preferred strategy for pants (74% of the group), but they also used tracing (18%) and instrument (18%) forms. Some Bedouins (36% of the group) and Americans (11% of the group) represented jacket using the touch form. For the minor type we termed "body part", gloves were likely to elicit this particular form (9% of Bedouins, 5% of Americans). Tracing was used for objects like comb (9% of Bedouins, 5% of Americans), hat (18% of Bedouins, 11% of Americans), and pants (16% of Americans). The object pattern, where the hands show the shape and dimension of the item without action, was seen in American non-signers only for fork (5% of the group) and pants (5% of the group).

The diversity of types of responses other than handling demonstrates the range of possibilities for silent gesture, but clearly handling is favored for this set of items (mean average of 79% of items for Bedouin and American hearing non-signers combined), followed by instrument (21% of items). As we studied their responses more closely, we found that some hearing participants tried to differentiate pairs of items that were similar to each other in form and action. Our set included pairs of items with similar human actions such as: broom-rake, mop-vacuum, and spoon-fork. Some respondents used a different, non-handling strategy for the second member of the pair, but most continued to use handling. Among those who used handling, some varied the movement (e.g., sweeping side to side for broom vs. pushing, then dragging for mop), or added a second gesture such as shivering to differentiate a jacket (test item) from a shirt (practice item).

Preferential patterning in a new sign language, Al-Sayyid Bedouin Sign Language

Al-Sayyid is a community of about 3,500 Bedouins in southern Israel, of whom about 130 are deaf. ABSL is used widely by both deaf and hearing members in the community as a second language to spoken Arabic. Deaf Bedouins interact daily with hearing family members and hearing neighbors and relatives in the village. The

sign language ability of hearing Bedouins in the village varies, with excellent ABSL skill seen in hearing siblings close in age to deaf signers, and less skill among those in the village who do not have deaf children or a deaf sibling in the immediate family.

We find that ABSL signers overwhelmingly prefer the instrument type over handling when asked to identify the same items we showed to hearing Bedouins in a neighboring village (Figure 4, Table 3). They prefer the instrument type in 82% of their responses compared to only 28% in the hearing Bedouins' responses.

The preference for instrument forms ranged from a high of 92% of items for two participants, and a low of 67% for one participant, the single ABSL signer who is hearing. Twenty-three percent of their responses involved handling forms, 6% object, and 1% tracing. Though all the ABSL signers produced some handling forms, they did so at a much lower rate compared to hearing Bedouin gesturers (73% of items). Object forms were produced by only four ABSL participants as size classifiers (see Figure 6 for examples of handling, instrument, and object forms for 'spoon'), and tracing, in only two. In these cases, the two strategies occurred in conjunction with either an instrument or handling form. ABSL signers also produce other minor strategies, tracing and touching, but far less frequently than the non-signing Bedouins.

'spoon'
handling

'spoon'
instrument

'spoon'
object (classifier)

Figure 6. ABSL signers' use of *handling*, *instrument* and *object* strategies

The ABSL participants all used an instrument form for 12 items (comb, gloves, handsaw, hat, knife, lipstick, nail polish, paintbrush, pants, rake, scissors, screwdriver). All participants produced the handling form for jacket, and all but two produced handling forms for hairdryer and hammer. For 92% of the items, 70% of the ABSL signers used the same type in their response, showing high consistency. The items for which the types were more equally divided between instrument and handling were cellphone, mop, and spoon. The single older second-generation deaf signer in the group exhibits the instrumental pattern as strongly as younger deaf signers, suggesting that the pattern may have emerged early in the language, but at the very least, it is shared by both younger and older signers.

ABSL signers did not always have the *same sign* for an item, but they had high agreement on the *type* of sign. Figure 7 shows three different ABSL signs for comb, the first with a closed-V handshape, the second with a closed-5 handshape, and the third, a bent-5 handshape. The directions of movement are also different; some move downward over the head and some move back over the top of the head. Generally, ABSL signers have a higher degree of sign variation within the village compared to ASL signers, with different families having different signs for common objects (Israel & Sandler, 2012). What we observe in ABSL is rapid conventionalization of the lexical pattern, if not the individual sign itself.

'comb' instrument | 'comb' instrument | 'comb' instrument

Figure 7. Three different ABSL signs for 'comb', all using instrument type; each signer is from a different family

Preferential patterning in an established sign language, American Sign Language

ASL users prefer the instrument type, though at a lower average rate of 65% of the items when compared to ABSL signers (Figure 4, Table 3). The lower average rate may be because of the availability of other systems in ASL for naming items. Many nouns in ASL are fingerspelled, particularly for low-frequency items like mop and vacuum. Some ASL signers responded using only fingerspelled words for some items. Altogether for ASL participants, strategies other than instrument and handling were: 8% fingerspelling, 4% object, and less than 1% with arbitrary sign and tracing.

The object type, which lacks human action movement related to the object, was contributed almost entirely by a single participant who added these forms to 50% of her responses as classifiers. Most ASL signers only named the items in each slide, but this participant understood the task to include describing the position of items in the picture, 'laid side by side', or 'next to each other'. Her classifier forms were all of the object type. These forms lack movement because of their flexible function: they are used to describe size and shape of objects absent their human function. In none of the ASL responses were object forms used as the only response in place of either a handling or instrument strategy.

Generally, object and tracing types occurred either before or after instrument or handling forms as additional ASL signs. Six participants out of 12 produced fingerspelled words as names for at least one of the items.

All ASL participants produced the instrument form for spoon, scissors, rake, paintbrush, and knife. The signs for fork, hairdryer, hat, and screwdriver were predominantly produced with the instrument type, each with only one exception. All participants produced the handling form for hairbrush, hammer, mop, and vacuum. Overall, there was more than 70% group agreement on type among ASL participants for 88% of the objects, compared to 92% of objects found among ABSL participants. The items for which the response types were divided between instrument and handling preference for ASL signers were cellphone, broom, and mascara.

Responses of ABSL and ASL signers contrast with their hearing non-signing counterparts, who preferred handling much more strongly. Moreover, neither ABSL nor ASL users produced object, tracing, and touch strategies without also producing instrument or handling forms, whereas there were cases of non-signers producing object, tracing and touch types alone.

Preferential patterning in another established sign language, New Zealand Sign Language

On the basis of data from ASL and ABSL, one might conclude that sign languages always favor instrument forms, but data from NZSL shows this is not the case. NZSL signers use the handling type more often than ASL and ABSL signers, producing the forms at an average rate of 67% of the items (Figure 4, Table 3). Thirty-six percent of NZSL signers' responses used the instrument type and less than 1% of the responses used any other type. All NZSL participants produced handling forms for the majority of the items, and all produced instrument forms for some of the items.

All NZSL participants produced handling forms for 10 of the target items: broom, hairbrush, hammer, hat, jacket, lipstick, mop, nail polish, screwdriver, and spoon, and all produced instrument forms for 4 items: fork, rake, scissors, and knife. Overall, there was a greater than 70% group agreement on type among NZSL participants for 96% of the items, that is, for all but one item, mascara, which was almost evenly divided with handling and instrument forms. All signers' responses contained either handling or instrument forms, except one participant who used a tracing form once.

Though NZSL signers use more handling forms, they nonetheless use instrument forms more than either group of hearing non-signer participants. Instrument forms are often used by NZSL signers to distinguish between pairs of items with

similar movements: spoon/fork, broom/rake, and brush/comb. Interestingly, the signers always chose the same item in the pair for the instrument strategy; they used the handling strategy for broom, brush, and spoon but instrument for rake, comb and fork, and never the reverse. Comb varied more than the other two; most NZSL signers used handling (86% of participants), but instrument forms were attested in 14% of participants. Pairs of handling-instrument items in NZSL may exist as a strategy for related vocabulary, but it is apparently not a strategy for ASL participants, who typically use instrument forms for all of these items.

NZSL signers often supplemented their handling forms with silently pronounced or "mouthed" English words for the item while signing (Bank et al., 2011). For those NZSL signers who used handling forms for both brush and comb, they distinguished them by mouthing the English words. Mouthing is a means of marking nouns in many sign languages (Crasborn et al., 2008), and it comes into play in our study with respect to distribution of handling and instrument forms in the language.

Summary of results

Across three sign languages, signers use more instrument forms overall for handheld tools (82% of items in ABSL, 65% ASL, 36% NZSL) than hearing non-signing gesturers (28% of items for Bedouins, 17% Americans) (Figure 4, Table 3). Though NZSL signers do not use instrument forms as often as ASL signers, they use the type more often than non-signers to differentiate between items that have almost identical human actions (grooming the hair for brush and comb, eating with utensils for spoon and fork). Compared to ASL and NZSL, ABSL signers use more instrument forms. Their strong preference is exhibited even in the responses of the oldest signer who is one generation removed from the first four signers to appear in Al-Sayyid.

Non-signers use many more handling forms (83% of items for Americans, 73% for Bedouins) than signers do (67% of items for NZSL, 35% for ASL, 23% for ABSL). The instrument strategy and other gesture types appear at lower rates, and are more variable within and across groups of non-signers. For example, showing or touching a part of the body as a response was used only by hearing non-signers and not any of the signers. Across all groups, signers and non-signers, the most common types for identifying tools are handling and instrument, with the next most frequent being the object forms but they were used only by a few signers (Figure 4, Table 3).

Discussion

Our exploration of iconicity in sign languages and silent gesture raises a key question about the pattern for tools that we observe. Why is it the case that the handling and instrument types are the most frequently used for tools in all groups, compared to the other types that are far fewer in number? Both represent human action, and it appears that this is the key iconic feature for this category of items. Hand-held tools share certain properties: they are manufactured, they are small enough to be grasped by human hands, and they are designed for a specific purpose. Tools are also cultural artifacts, designed for particular kinds of human actions on the world (Brown, 1995). Handling and instrument strategies have a broad variety of possible handshapes, movements and locations, compared to body-part or tracing strategies, which makes them ideal for representing the ubiquity of tools in the human environment. Hammers, screwdrivers and hand-saws are designed for different purposes, and can be visually distinguished by showing differences in human actions, as well as how they are held (handling) or their shapes (instrument) in use.

Why do signers use more instrument forms compared to hearing non-signers? Though signers in each sign language vary in frequency of use of instrument forms, all groups of signers use more instrument strategies than hearing non-signers. Perhaps instrument forms expand the sign language lexicon by adding more handshape distinctions. Brentari et al. (2012) compared signers' and non-signing gesturers' responses to pictures and video vignettes of objects with and without the presence of a human agent. They find that both groups reliably produce more "object-classifier" forms (where hands describe features of the object) when they are shown stimuli without agents. Because the focus of their study was to compare handshape complexity across groups, they did not report the rates of handling responses compared to other forms produced by signers and gesturers. In our study, where we used only pictures as stimuli, we found a strong handling preference in both groups of gesturers, demonstrating that the handling preference does not solely derive from a visible presence of human agents. It appears that tools as a category of stimuli strongly elicits forms exhibiting human agency. Gesturers and signers alike represent human agency through characteristic movements and locations, for example, the action of brushing side to side near the mouth for 'toothbrush'. Schembri et al. (2005) find that non-signing Australians and signers of Australian Sign Language exhibit similar movements and locations in response to a task involving classifier predicates of motion but differ in their choice of handshapes. Our results converge with these previous studies showing that signers' handshapes are likely to be what distinguish them from gesturers.

A key finding from our data is that the preference for instrument forms seems to emerge quickly in a new sign language. Among ABSL signers two and three generations removed from its origin, instrument forms are not only higher in frequency compared to handling, but the preference is stronger than for the two established sign languages. One might speculate that the preference for handling strategy in hearing non-signing Bedouins should persist in signers of a new language, particularly in villages where there is a high degree of interaction between hearing gesturers and deaf signers in the first and second generations. However, this is not the pattern we see. We speculate that the quick emergence of instrument forms in ABSL may come from a pressure to distinguish between actions and objects, and to direct focus to objects, with more noun-like representations, especially if the strategy is action-based. In ABSL the instrument pattern may be used more consistently than in ASL because the new language has yet to develop multiple means of marking nouns in the language. Tkachman and Sandler (2013) find that ABSL does not have noun-verb pairs as does ASL (Supalla & Newport, 1978), for example, nor does ABSL use mouthing or fingerspelling.

Conclusion

With the handling/instrument pattern, we have identified an example of a gestural iconic patterning in three different sign languages. The body, the hands, and the face are all available not only for linking individual forms with their referents, but also for linking groups of forms having related semantic properties. Our study with tools explores the nature of lexical structure in sign languages and how bodily resources are selected for purposes of iconic representation. Comparing ABSL signers with Bedouin hearing non-signers shows that a distinct lexical patterning can become differentiated from gesture in a relatively short time. Sandler et al. (2005) find that consistent word order appears by the second generation of signers in Al-Sayyid. Lexical patterning of hand-held tools is another likely candidate for a structure that emerges early, possibly earlier than a stable and conventionalized lexicon (Israel & Sandler, 2012).

Sign language researchers have identified a number of structures that are found across human languages whether signed or spoken, for example, wh-questions or dependencies across clauses (Sandler & Lillo-Martin, 2006; Zeshan, 2004). At the same time, the field has drawn attention to structures that are less easily compared to spoken languages, such as classifier predicates of motion, verb agreement and deixis (Liddell, 2003). Here, we add patterned iconicity and lexical structure to the latter group. Patterned iconicity seems suited to sign languages because it takes advantage of the visual-gestural possibilities of the human body in ways that are

less available in spoken languages but available in gesture. In the handling and instrument pattern, signers and gesturers alike convey information about human activity with man-made tools along with their visual properties (their size and shape, and how they are held). Patterned iconicity brings a new dimension to the study of sign languages because it does not involve deixis or space, instead it reveals the central role of the body in organizing meaning in language. We believe the existence of such patterns deepen our understanding of the role of modality in human language.

Acknowledgements

This work was supported by funding from NIH R01 DC 6473. We thank Adam Stone and Matt Hall for assistance with pilot testing. We also thank David McKee for gathering data on New Zealand Sign Language, and Calle Börstell and Ismail Abu Freh for data on hearing Bedouins.

Notes

1. We used a male contact who lived in the village to arrange testing. Because of cultural views restricting contact between unrelated men and women in this as well as in neighboring villages, our contact person recruited only male friends and relatives for the elicitation.

2. In a pilot test, we used native and non-native ASL signers and found no reliable difference in their responses, leading us to determine that for at least very familiar, everyday objects, native language ability is not a requirement.

3. The original data set contained 27 items, but 3 were dropped from the analysis. One item was frequently misidentified by subjects (nail file) and the remaining two often elicited responses outside the frame of the video camera (shoes and socks).

4. The non-dominant hand plays a role in silent gestures and signs, such as to provide grounding for actions and other representations on the dominant hand. In this study, we coded only for the dominant hand in order to test the applicability of our coding scheme across sign and gesture.

5. The instructions to participants were somewhat different in our study. In the previous studies, participants were asked to "show how the tools are used" which may have encouraged more action-type gestures. In this study, we asked participants to "use your hands to tell us what this object is".

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