

What's in a gesture

On verbs, nouns, actions and objects as reflected in gestures of persons with and without aphasia

Elisabeth Ahlsén
University of Gothenburg
Gothenburg, Sweden
eliza@ling.gu.se

Jens Allwood
University of Gothenburg
Gothenburg, Sweden
jens@ling.gu.se

Abstract

This study treats the semantic interpretation of co-speech gestures produced with nouns and verbs. One set of 30 gestures was originally produced in conversation by speakers with aphasia, whereas another set of 30 gestures was produced by speakers without aphasia. Each gesture was mimicked by the experiment leader to a panel of judges. The interpreted meaning was written down by the panel of 13 subjects, 7 with the same linguistic and cultural background as the original producers and 6 with other linguistic-cultural backgrounds. The purpose was to study the possible influence on the interpretations of (i) aphasia – no aphasia, in the originally producing group, (ii) cultural background in the panel, (iii) verb vs. noun (or action vs. object orientation) of the originally co-produced word, and (iv) the level of abstraction of a gesture-word-combination. The results showed no influence from aphasia in the producer or cultural background in the interpreting panel. Action gestures tended to be more frequent for both persons with and without aphasia than object gestures and were used also with some nouns. The level of abstractness was captured in the interpretation of about 75% of the items and in the remaining 25%, the interpretations tended to be more abstract than the originally co-produced word.

Keywords: gesture, aphasia, action gesture, object gesture, abstractness

Introduction

This study investigates the types of co-speech gestures that occur with verbs and nouns in the speech production of a number of persons with aphasia and in a reference database of gestures produced by persons without aphasia. A pilot study was carried out with the purpose of finding out what semantic-

semiotic features could be identified in a number of gestures produced by (i) persons with aphasia and (ii) persons without

aphasia. The range of semantic features occurring in the interpretations of a certain gesture can be interpreted as the meaning potential of that gesture, i.e. what elements of meaning/-s can be associated with it (Allwood 2003). The panel of judges were 13 academics, 7 of which had the same cultural-linguistic background as the persons originally producing the gestures (Swedish) and 6 of which had other cultural-linguistic background.

Background

The meaning of bodily expressions is less clear than that of vocal verbal expressions, since it is less conventionalized and to a greater extent dependent on indexical and iconic information (cf. Peirce 1932). The relation of gestures and words have been described from two quite different standpoints and also from some intermediate positions. The first standpoint is that iconic gestures and speech are “inextricably intertwined” in development and generation and thereby both interdependent and simultaneous. This is the view of McNeill (1992, 2000), who assumes a common “growth point” for words and iconic gestures. From this type of standpoint, if words are impaired, so are gestures. The opposing standpoint is that words and gestures are independent and that gestures have a mainly self-activating role in facilitating speech production (Hadar et al 1996, Hadar & Butterworth 1997, Beattie & Shovelton 2000, 2002, 2004, 2005). An intermediate view is that gestures are closely related to words, but to some extent independent and more robust. The two latter standpoints harmonize with the view that gesture came earlier in evolution, can be

more robust and can therefore be used for compensation when word finding/production is impaired. In this view, iconic gestures can be replacing words or adding information and they can sometimes be more preserved in aphasia (e.g. Feyereisen & Havard 1999, Ahlsén 1991, Lott 1999). Thus, gestures can be closely related to speech and possibly disturbed when there is a language disorder like aphasia, but, at the same time, they can still be more robust and fill a compensatory function.

There are some hypotheses about what gestures can do for speech, i.e. facilitate word finding and structuring of the spoken contribution. De Ruiter (2006) reports studies by Rimé, Schiaratura, and Ghysseleinckx (1984), Graham and Argyle (1975), and Graham and Heywood (1975), where the relation between speech and gesture concerning the activation of *spatial features* has been interpreted in different ways with respect to activation of speech. De Ruiter proposes own problem detection and reallocation of communicative content between modalities as a more communicative explanation. Kita suggested that analytic thinking organizes information by hierarchically structuring decontextualized conceptual templates (analytic templates) (Kita 2000, Melinger and Kita 2006). Raucher, Krauss & Chen (1996), among others, point out that *language production (i.e. the speech flow) is affected if the use of gesture is inhibited*. This also points to an activating or structuring function of gestures.

A number of proposed theories placing an increased focus on the functions of alignment, embodiment and mirroring functions in communication point to the importance of analyzing the role of gesture in relation to speech (cf. Gallese & Lakoff, 2005, Simmons & Barsalou 2003). Arbib (2005) strongly argues for stepwise evolution via first less complex and then more complex gestures to structured speech and language (an evolution from grasping an object to producing Verb-Argument-structures), drawing on mirror neurons and the fact that Broca's area developed on top of the mirror neuron (F4) area in the macaque.

How are gestures and speech related in terms of the brain areas and brain mechanisms involved? Suggestions, based on, among other things, brain activity data in perception experiments using fMRI (functional Magnetic Resonance Imaging) and ERP (Evoked

Response Potentials) have been put forward. The experiments have used paradigms like varying mismatch in words, gestures or both in relation to a previous utterance (e.g. Özürek et al. 2007) or varying the conditions of speech reception between the conditions of no picture, picture but no gesture, gesture matching speech and gesture mismatching speech (e.g. Wu & Coulson 2007). Several areas have been found to be active, but most hypotheses concern Broca's area and adjacent areas (BA45/47) and the premotor area (BA6). Broca's area, which has been found to be active in speech perception, especially perception of verbs of movement and tool based action and sentence processing, has also been found to be active in the perception of co-speech gestures. Özürek et al 2007) propose that Broca's area is a center for integration of speech and gesture perception. BA6 is an area which responds automatically to gestures and other actions. This activation can be modulated by preceding speech. It, thus, appears that brain areas of speech and gesture perception overlap and therefore it is hypothesized that the same type of perception is used for both in an integrated processing. A topic of discussion is how much this processing takes place mainly by activation of sensory-motor "perception maps" or by higher-level co-activation of networks and whether and whether these higher-level networks can be considered as "amodal" or just hierarchically coordinated sensory-motor (cf Simmons & Barsalou 2003). This touches on the relation between meanings and words as well as on the relation between nouns and verbs (Crepaldi et al. 2011). Two main questions are highly relevant for the present study of how gestures accompanying words can be interpreted. The first is (i) whether sensory and motor processing are linked, and the second is (ii) whether nouns and verbs use overlapping areas and are related to similar-related or basically dissimilar concepts.

Purpose and Research Questions

Specific questions in this study are:

- 1) Is there a detectable difference in how well subject can identify the meaning (here operationalized as the word originally accompanying the gesture) of reproduced gestures from the database produced by persons with aphasia and

from the database produced by reference persons without aphasia?

- 2) Is there a difference in the ability to identify the meaning and elements of meaning in gestures between persons with the same cultural and linguistic background as the persons producing the gestures and persons with a different cultural and linguistic background?
- 3) To what extent can a gesture be identified as having a main relation to a noun or a verb – or to an object or action related word?
- 4) To what extent can the level of abstractness of a gesture be identified? This question concerns whether a particular gesture illustrates a concrete word, such as “head” or a more abstract word, such as “conception”.

Method

Material

The analysis was based on gestures extracted from a database of 100 gestures produced together with a spoken noun or verb by 10 persons with aphasia and 100 gestures produced with a spoken noun or verb by 10 reference persons without aphasia. The data had been coded with respect to target word, gesture form, semantic features and a number of other variables. From each of the two data sets, 60 clearly identifiable hand gestures, associated with the spoken production of either a noun or a verb, were randomly selected and mimicked from the video – recording by the experiment leader, giving a total of 120 hand gesture stimuli.

Subjects and Procedure

The 120 hand gestures mimicked by the experiment leader were shown one by one in isolation (i.e. without context or accompanying speech) to a group of academics, 7 Swedish and 6 non-Swedish, in a group experiment, where they were asked to write down the meaning of the gesture or the closest related word (or phrase with target word underlined). The experiment leader was sitting in front of the group and showing each gesture with one repetition, then pausing until all the subjects had written down their

response, before mimicking the next gestures. (This procedure was chosen for two reasons: (i) to respect the anonymity of the persons with aphasia in the study, (i) to only produce the type of hand gesture without any context of other accompanying speech, facial expressions, context factors etc. Although there is an element of loss of authenticity in the procedure, the hand movements were quite distinct and easy to mimic.

Analysis

The written responses were analysed with respect to:

- the number of response words for each of the two data sets (aphasia and reference data set) corresponding to the words originally produced by the person making the gesture (i.e. the same word or a near synonym)
- the number of gestures originally produced with a verb, where the response was instead a noun and the number of gestures originally produced with a noun, that were responded to by a verb by the participants in the experiment
- the number of gestures where the word given by the participants in the experiment differed in degree of abstractness from the word produced by the person originally producing the gesture.

Results

The number of words in the responses corresponding to the words originally accompanying the gestures is presented in table 1.

The proportion of words that corresponded to the original word produced with the gesture can be estimated to somewhere between 16-20 percent. This means that the “target word” could be identified from the gesture alone, with no context, in about 1/5 or a little less of the cases.

The question of whether “target words” would be harder to identify in relation to hand gestures originally produced by persons with aphasia than to hand gestures originally produced by reference persons (question 1) was negatively answered. The gestures produced by persons

with aphasia were as easy to interpret as (or possibly easier than) the gestures produced by the reference group.

Table 1. Number of words corresponding to the word originally accompanying the gesture

	Reference database	Aphasia database
<hr/>		
Subject:		
A. Swedish	12	16
B. Swedish	11	12
C. Swedish	7	13
D. Swedish	12	16
E. Swedish	10	9
F. Swedish	10	12
G. Swedish/ Eng/Norw	7	7
<hr/>		
Total Swedish	69	85
Mean Swedish	9.86	12.14
<hr/>		
H. Italian	11	8
I. Arabic	7	9
J. Pakistani	9	11
K. Turkish	11	11
L. Chinese	10	12
M. Chinese	8	11
<hr/>		
Total non-Swedish	56	62
Mean non-Swedish	9.33	10.33
<hr/>		
Total	56	61
Mean	9.33	10.10

Considering the similarity in cultural background between the subjects in the experiment and the persons originally producing the gesture (question 2), there was no statistically significant difference in ability to identify the “target word”, although the persons with non-Swedish background had slightly lower numbers. It can, thus, not be hypothesized from this pilot experiment that cultural-linguistic background plays a substantial role in the ability to interpret spontaneously produced gestures occurring with verbs and nouns.

A tendency to produce action-oriented gestures with not only verbs, but also nouns, has been noticed in the original database

(Ahlsén & Schwarz, 2012). This can occur because the noun itself is action oriented, (e.g. a cut, a throw) or because the gesture is perhaps more holistically related to a whole phrase or clause or related to an adjacent verb.

Table 2. Number of verb responses to gestures originally produced with nouns.

	Reference Database	Aphasia database
<hr/>		
Subjects		
A. Swedish	3	1
B. Swedish	2	1
C. Swedish	2	1
D. Swedish	2	1
E. Swedish	2	1
F. Swedish	3	1
G. Swedish /Eng/Norw	1	1
<hr/>		
Total Swedish	15	7
<hr/>		
H. Italian	4	0
I. Arabic	3	0
J. Pakistani	2	0
K. Turkish	2	1
L. Chinese	3	0
M. Chinese	1	0
<hr/>		
Total non-Swedish	15	1
<hr/>		
Total	30	8

There were considerable differences in how many verbs are given as responses for hand gestures originally produced with nouns by persons with and without aphasia (question 3). The frequency is fairly low in both groups, but clearly higher for the gestures produced by persons without aphasia (30 vs. 8).

The different items varied with respect to how much the level of abstractness of the response words matched that of the words originally produced with the corresponding gestures (question 4). All in all 25% of the responses were clearly at a different level of abstractness than the original words, the vast majority of these being more abstract interpretations of the gestures.

Example 1-3 below illustrates the responses from our 13 subjects (A-M) for two gestures originally co-produced with the verbs for “been placed” and “shrinks” and with the noun “tree”.

Example 1)

Originally co-produced with: “Been placed” (Sw. placerats)

Gesture: Both hands in front of chest, about 20 cm apart with palms towards each other, movement up and down to the right.

Responses.

- A. Moving object
- B. Putting in one place
- C. Division, first, then (abstr)
- D. Throw away (thrash)
- E. Put there
- F. End of discussion (abstr)
- G. Roof top (A->O)
- H. Put it on a side, forget (abstr)
- I. Indicating fed up (abstr)
- J. Put it somewhere
- K. Throw something down
- L. Put sth down to the right side
- M. Put it somewhere/there

Most of the responses are related to placement ((9 out of 13) and one of them is adding also an abstract interpretation “put it on a side, forget”. Other, more abstract responses are: “division, first, then” and “indicating fed up”, There are two noun responses “roof top” (concrete, focusing on the form of the gesture) and “end of discussion” (more abstract).

Example 2)

Originally co-produced with: “Shrinks” (Sw. krymper)

Gesture: both hands in front of stomach, palms toward each other, fingers bent, about 50 cm apart, movement of hands coming together with some tension, slowly, leaving a smaller distance between them (about cm).

Responses:

- A. Sphere (A->O)
- B. Together (abstr) (A->adv)
- C. Press together -> focus on something (abstr)
- D. Focus (V), condense (abstr)
- E. Make it smaller
- F. Put together
- G. Coming together

H. Put all together/assemble it

I. Almost done

J. -

K. Smaller, something is getting smaller

L. Squeeze the object

M. Put them altogether/make it smaller

Only three of the responses contain the focused meaning of shrinking: “make it smaller”, “smaller, something is becoming smaller” “making it smaller”. The meaning of coming or putting together seems more immediate, as in “press together”, “put them together”, “coming together, put all together/assemble it” and “put them all together. This meaning can also be more abstract, as in “focus on something” and “focus, condense”. Another abstract interpretation is “almost done” (possibly taking the gesture as time or a task shrinking). Finally, there is one noun interpretation “sphere”, focusing on the form of the gesture.

Examples 3)

Originally produced with: “Tree” (Sw. träd)

Gesture: both hands lifted high in front, palms towards each other, first close, then lowered coming further apart, then coming together again to about 10 cm apart, then lowered in parallel about 30 cm.

Responses:

- A. Showing a shape – possibly woman
- B. A man or a person
- C. Round at the top getting thinner – showing form
- D. Tree
- E. Showing the shape of something
- F. Show the form
- G. Female earth mother (showing hip rounding)
- H. “This shape”
- I. -
- J. -
- K. Symbolizing a woman/female body”
- L. A tree
- M. Narrow it down

All of the subjects (except two, who gave no response), gave an interpretation of the form of the gesture.

Discussion and conclusions

This study was an exploratory pilot study involving only a small group of participants. It can, thus, be the basis of hypotheses to be tested further on a larger population, rather than more definite conclusions.

Regarding question 1, the finding that the meaning of gestures produced by persons with aphasia was not harder to interpret (in terms of identifying the originally co-produced word) than the meaning of gestures produced by other persons is indicative of similarities in the use of gestures and no general loss of the ability to make comprehensible gestures caused by the aphasia, when there are no noticeable word finding episodes. Both words and gestures were produced by the subjects in the sample used for this study. It does, thus, not directly address the question of gestures occurring in word search episodes where there are noticeable word search/word retrieval problems, which remain to be studied. Such studies will add information about the possible activating and/or compensatory role of gesturing with respect to word production.

The study does not point to any major differences in the ability to identify the meaning of a gesture depending on cultural and linguistic background (question 2), i.e. same or different culture and language as the language producer. The group of subjects is, however, small and represents only five different languages, although they are from widely different parts of the world. The results, however, point in the direction of more general principles for interpreting gestures that apply across cultures and languages, which would make at least some gestures more robust than spoken words in intercultural communication.

The finding that there is a clear difference in how many gestures originally accompanying nouns that elicited verbs as responses between the gestures produced by persons with and without aphasia (30 vs. 8 instances) is interesting (question 3). There can be many reasons for this result. One reason is that the non-aphasic reference database contains a higher frequency of iconic action gestures accompanying nouns than the aphasia database (Ahlsén & Schwarz forthcoming). The reason for this, in turn, could be that the non-aphasic speakers have a higher speech rate. It could then, possibly, be quite easy, especially for a slow and/or complex gesture, to “spill over” in

temporal co-occurrence from a verb to a noun. Gestures could also be more holistically planned in relation to chunks or phrases of speech. Many people with aphasia tend to speak slower and perhaps focus more on each word. Since persons with aphasia have greater difficulties in general in mobilizing nouns, they might also therefore have a tendency to produce more gestures related to nouns.

Iconic gestures are produced with abstract as well as concrete nouns and verbs (question 4). What makes a person interpret a gesture as more abstract is probably the accompanying word and other context. In this experiment, such context is missing. The subjects, however, do interpret gestures as related to quite abstract words in almost 25% of the cases, as we have seen.

In ordinary face-to-face interaction, there are several converging sources of information, three important sources being the *meaning potentials*, i.e. the possible meanings of a gesture and of a word in a specific context.

How does the *meaning potential* of a particular gesture restrict the interpretation of the accompanying word and vice versa? For example, if a person raises his/her hand, this could mean several things, if he/she says the word *big* this could also mean several things (c.f. a big grape or a big house), but if the raised hand and the word *big* are coproduced, the merged meaning potentials restrict the meaning of both expressions. In this study, only the meaning potential of gestures in isolation was studied. In a future study, we hope to study how the meaning potential of gestures and speech are integrated and, thus, contribute to an investigation of how in face-to-face interaction the multimodal integration of meaning potentials facilitates understanding.

Acknowledgements

This research has been supported by the European Community's seventh Framework Programme (FP7/2007-2013) under grant agreement no.231287(SSPNet) and by the project: "Multimodal Corpora in the Nordic Countries" under the NORDCORP program, the Nordic Research Council for the Humanities and the Social Sciences (NOS-HS).

References

- Ahlsén, E. (1991). Body communication and speech in a Wernicke's aphasic – A longitudinal study. *Journal of Communication Disorders*, 24, 1–12.
- Ahlsén, E. (2011). Towards an integrated view of gestures related to speech, *Proceedings of the 3rd Nordic Symposium on Multimodal Communication*. Editors: Patrizia Paggio, Elisabeth Ahlsén, Jens Allwood, Kristiina Jokinen, Costanza Navarretta. *NEALT Proceedings Series*. 15 (2111) s. 72-77.
- Ahlsén, E. & Schwarz, A. (2013). Features of aphasic gesturing. *Clinical Linguistics and Phonetics*. (Early online doi:10.3109/02699206.2013.813077).
- Allwood, J. (2003). Meaning Potential and Context. Some Consequences for the Analysis of Variation in Meaning. In Cuyckens, Hubert, Dirven, René & Taylor, John R. (eds). *Cognitive Approaches to Lexical Semantics*. Moulton de Gruyter, pp. 29-65.
- Allwood, J. (2008). Dimensions of Embodied Communication - towards a typology of embodied communication. In: Ipke Wachsmuth, Manuela Lenzen, Günther Knoblich (eds.) *Embodied Communication in Humans and Machines*, Oxford University Press.
- Arbib, M. (2005). From monkey-like action recognition to human language: An evolutionary framework for neurolinguistics. *Behavioral and Brain Sciences*, 28, 105–124.
- Beattie, G. W., & Shovelton, H. K. (2000). Iconic hand gestures and predictability of words in context in spontaneous speech. *British Journal of Psychology*, 91, 473–492.
- Beattie, G. W., & Shovelton, H. K. (2002). An experimental investigation of some properties of individual iconic gestures that mediate their communicative power. *British Journal of Psychology*, 93, 179–192.
- Beattie, G. W., & Shovelton, H. K. (2004). Body language. In *Oxford companion to the mind*. Oxford: Oxford University Press.
- Beattie, G. W., & Shovelton, H. K. (2005). Why the spontaneous images created by the hands during talk can help make TV advertisements more effective. *British Journal of Psychology*, 96, 21–37.
- Crepaldi, D., Berlinger, M., Paulesu, E., & Luzzatti, C. (2011). A place for nouns and a place for verbs? A critical review of grammatical-class effects. *Brain and Language*, 116, 33–49.
- De Ruiter, J. P. (2006). Can gesticulation help aphasic people speak, or rather, communicate? *Advances in Speech-Language Pathology*, 8, 124–127.
- Feyereisen, P., & Havard, I. (1999). Mental imagery and production of hand gestures while speaking in younger and older adults. *Journal of Nonverbal Behavior*, 23, 153–171.
- Gallese, V., & Lakoff, G. (2005). The brain's concepts: The role of the sensory-motor system in reason and language. *Cognitive Neuropsychology*, 22, 455–479.
- Graham, J. A., & Argyle, M. (1975). A cross-cultural study of the communication of extra-verbal meaning by gestures. *International Journal of Psychology*, 10, 57–67.
- Graham, J. A., & Heywood, S. (1975). The effects of elimination of hand gestures and of verbal codability on speech performance. *European Journal of Social Psychology*, 5, 189–195.
- Hadar, U., & Butterworth, B. (1997). Iconic gesture, imagery and word retrieval in speech. *Semiotica*, 115, 147–172.
- Hadar, U., Wenkert-Olenik, D., & Soroker, N. (1996). Gesture and the processing of speech in aphasia. *Brain and Language*, 55, 180–182.
- Kita, S. (2000). How representational gestures help speaking. In D. McNeill (Ed.), *Language and gesture: Window into thought and action* (pp. 162–185). Cambridge, UK: Cambridge University Press.
- Lott, P. (1999). *Gesture and aphasia*. Bern: Peter Lang.
- McNeill, D. (1985). So you think gestures are nonverbal? *Psychological Review*, 92, 350–371.
- McNeill, D. (1992). *Hand and mind*. Chicago: The University of Chicago Press.
- McNeill, D. (2000). *Language and gesture*. Cambridge, UK: Cambridge University Press.
- McNeill, D. (2007). *Gesture and thought*. Chicago: University of Chicago Press.
- Melinger, A., & Kita, S. (2006). Conceptual load triggers gesture production. *Language and Cognitive Processes*, 22, 473–500.
- Özyürek, A., Willems, R. M., Kita, S., & Hagoort, P. (2007). On-line integration of

- semantic information from speech and gesture: Insights from event-related brain potentials. *Journal of Cognitive Neuroscience*, 19, 605–616.
- Peirce, C. S. (1932). *Collected Papers of Charles Sanders Peirce*. Harvard University Press.
- Rauscher, F. H., Krauss, R. M., & Chen, Y. (1996). Gesture, speech and lexical access: The role of lexical movements in speech production. *Psychological Science*, 7, 226–231.
- Rimé, B., Schiaratura, L., & Ghyselinckx, A. (1984). Effects of relative immobilization on the speaker's nonverbal behavior and on the dialogue imagery level. *Motivation and Emotion*, 8, 311–325.
- Simmons, K., & Barsalou, L. W. (2003). The similarity-in-topography principle: Reconciling theories of conceptual deficits. *Cognitive Neuropsychology*, 20, 451–486.
- Wu, Y. C., & Coulson, S. (2007). How iconic gestures enhance communication: An ERP study. *Brain and Language*, 101, 234–245.