

# **Determining the Function of Gestures: An Analysis of the Evidence for the Communicative and Facilitative Hypotheses**

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## **Abstract**

In the field of psycholinguistics there has been much discussion and investigation into why people gesture. This paper reviews the literature on the interdisciplinary studies of gesture by firstly identifying the underlying theories of speech and gesture production; followed by definitions of gestures, gesture typology, and gesture roles. This paper then goes on to analyze and discuss the evidence for each of the opposing views, the communicative function and the facilitative function, regarding the purpose of gesture and concludes that neither camp's evidence negates the other indicating that gesturing has a dual purpose.

*Keywords:* gestures, psycholinguistics, communicative function, facilitative function

For many years, in the interdisciplinary field of gesture studies, the question of why people gesture has been much debated among 'two camps' (de Ruiter, 2003: 338). Kendon (1994) and McNeill (1992) maintain that people are interactionally spurred to gesture for others (i.e., the listener), primarily as a communicative function. Other researchers claim that people gesture for themselves (i.e., the speaker) as a facilitative function to aid with thinking and language production (Krass, Morrel-Samuels, & Colasante, 1991). The long-debated question as to why people gesture has been whether the function is solely communicative or solely facilitative. The fact that there is empirical evidence that supports each hypothesis suggests that gesturing may have a dual purpose.

This paper chiefly examines the empirical evidence presented by advocates of the facilitative function hypothesis in order to determine how sufficiently it answers the question as to why people gesture. Following a review of the literature, this paper will be split into three parts. Firstly, the paper will provide an analysis of the evidence supporting the facilitative function hypothesis, followed by a discussion of that evidence in answering the question as to why we gesture with reference to the communicative hypothesis also being made. Finally, this paper will reflect on the full range of previously discussed factors to determine which camp's evidence sufficiently answers the long-debated question.

## **Literature review**

The literature reviewed for this paper falls into four parts; firstly, identifying the underlying theories of speech and gesture production; secondly, defining gestures, gesture

typology, and gesture roles; thirdly, there is a brief review of the interdisciplinary studies regarding the communicative function of gesture; and lastly, a brief review of the research regarding the facilitative function of gesture. Due to a lack of space a full discussion of the vast literature cannot be undertaken, however, for the purposes of this paper the following should suffice.

### **Speech and Gesture Production—Theoretical Principles**

If gestures are for speakers, then the question to answer is what is its function in speech production. According to Levelt's (1989) speech production model, a speaker first conceptualizes and prepares their intended communication, then formulates the communication into a grammatically, phonologically and phonetically encoded linguistic structure by accessing the mental lexicon. Lastly, the speaker articulates the intended communication.

Theorists hypothesize that speech and gesture either embody two separate but tightly integrated systems (see de Ruiter's (2017) Asymmetric Redundancy Sketch Model, formerly de Ruiter's (2000) Sketch Model; also see Kita, & Özyürek's (2003) Interface Model); or that they arise from a single conceptual system (McNeill's (1992) Growth Point Theory). McNeill's (1992) theory suggests that speech and gesture are derived from a single conceptual system in which a communication consists of both a linguistic and visuo-spatial structure that are inseparable. As Clough and Duff (2020) note, it is evident, irrespective of whether they form a single conceptual system or two closely integrated systems, that gesture and speech are integral parts of human communication closely tied in function, time, and meaning.

Researchers have identified that gesture processing occurs in the same parts of the brain (Broca's and Wernicke's areas) used by speech and sign language (Xu *et al.*, 2009). This supports McNeill's (1992) notion that gesture and spoken language are both part of a solitary semiotic system that underlies human communication. The relationship between gesture and speech is further evidenced by the use of gesture by congenitally blind speakers even in the presence of blind listeners (Iverson, & Goldin-Meadow, 2001).

Data from neuroimaging and behavioral studies supports the embodied-cognition framework which suggests that all language is based in sensorimotor experiences and stem from 'rich memory representations of the world around us' (Clough, & Duff, 2020: 3). The connection between gesture and speech has significant inferences as gesture is motoric in nature and, as with speech, arises from vivid memory depictions and experiences. For example, face, or upper and lower limb movement resulting from the triggering of the corresponding area of the motor cortex when reading body-part related action words (Clough, & Duff, 2020). When individuals consider perceptual states and motor actions, cerebral activations occur. Hostetter and Alibali's (2008, 2010, 2019) Gesture as Simulated Action framework suggests that consequently gestures are automatically produced, and that when motor or visuospatial simulations are activated then speakers gesture more. In short, gesture has the capability to both reflect and affect cognitive processes.

### Defining gestures, typology and roles

Gesture, being integral to human communication, occurs across all known cultures and linguistic backgrounds (Feyereisen, & de Lannoy, 1991) and across lifespan (Dargue, Sweller, & Jones, 2019). Gestures are not universal in that they may have atypical meanings or may be interpreted differently depending on the context, culture or geography (Warren, 2013). Kendon (2004) defines gesture as observable actions that compose an utterance i.e., it is intended to communicate something. I would like to expand on this and offer a broader definition: Gestures are observable non-vocal actions that have specific functions in human communication. Gesture types can be classified as follows:

1. *iconic* (or *lexical* as Krauss prefers to refer to them)—these portray the size, shape, position, or action of an object (e.g., a description of how to use a lock). They are closely connected in time to the pertinent parts of what is being uttered.
2. *metaphoric*—these give abstract concepts concrete form (e.g., a finger motion resembling the ‘tiny’ size of something during the utterance of the word ‘tiny’).
3. *deictic*—these denote the location of an object often in proximate physical context (e.g., pointing to identify an object while making an utterance).
4. *beat or batonic*—these are brief, repetitive movements that coincide in time and rhythm with stressed syllables of speech for the purpose of emphasizing certain words, but lacking applicable meaning (e.g., using two fingers to tap a table while saying the word “danger”).
5. *emblems or symbols*—these have a defined meaning and are conventionalized gestures used in a specific cultural community and are often absorbed along with their first language (e.g. a head shake meaning ‘no’). These can be used to replace a whole utterance or to parallel it.
6. *pantomimes*—these mime an action or object and are mainly used instead of speech.

Gesture can be categorized and encapsulated in relation to differing situations and are broadly categorized as representative or non-representative gestures (Kita, 2000). Due to their symbolic nature, representative gestures can only be deduced in the context of speech and are contingent on the visibility of the gestures. To put it another way, for the communication to be successfully conveyed the listener must be in the speaker’s field of view. Alibabi *et al.* (2001) found that the frequency of representational gesticulation increases where the listeners are visible to the speaker. A point of interest is that speakers still produce representative gestures despite the listener not being visible to the speaker which indicates that representative gestures are integral to speech production. The listener’s presence only alters the rate of gesturing that occurs. Representative gestures include iconic gestures, metaphoric gestures and deictic gestures.

Non-representative gestures refer to gestures that are not related to the speech content, meaning beat or batonic gestures which are more connected to the rhythm of speech. Beat gestures are utilized irrespective of whether the listener is visible to the speaker or not (Alibabi *et al.*, 2001). In other words, non-representative gestures draw attention to the topic being

conveyed by accentuating specific words or phrases during speech, but do not refer directly to the narrative itself.

Some gestures have been found to be more beneficial for the listener than others. Iconic gestures that accompanied speech with unique information improved understanding the most. One study revealed that speakers gesture at higher rates when relaying a story after watching a cartoon as compared to after only hearing it (Hostetter, & Skirving, 2011). As Warren (2013) notes, researchers have established that gestures can do the following:

1. allow speakers to communicate some of the content they wish to convey to the listener
2. aid the speaker and listener in conversation management
3. portray some part of the communicated content iconically
4. guide the listeners' attentiveness
5. depict the spatiality and physical aspects of that being communicated
6. put emphasis on parts of the utterance
7. aid the speaker with retrieval from their mental lexicon
8. present significant insights into the processes of conceptualization and formulation

### **The communicative hypothesis**

Kendon (1994) is a renowned advocate for the communicative hypothesis in that he vehemently supports the notion that gesturing is for the listener. Substantial evidence exists that supports the notion that speakers' gestures benefit listeners, especially gestures which augment the information conveyed verbally (Valenzeno, Alibali, & Klatzky, 2003). When listeners are learning language, then gesture appears to be especially important to listeners in aiding comprehension. When listeners see speakers' gestures, they understand substantially more details of a story than without gesture (Beattie, & Shovelton, 2000). Studies investigating the role of deictic gestures to determine if listeners pay attention to gestures reveal that they do assist listeners in better understanding the veiled intention in speakers' messages (Kelly *et al.*, 1999). Regardless of whether gesture completes or contradicts speech, listeners do consider the information conveyed in gestures (Cassell, McNeill, & McCullough, 1999).

We should also consider what the intention of the speaker is in their use of gestures. Various studies have proven that the social context of human interaction can affect gestural communication. Alibali, Heath, & Meyers (2001) determined that speakers gesticulate more when conversing with a listener they can see rather than when conversing with somebody concealed by a screen, where speakers tended to use fewer demonstrative gestures. Similarly, Özyürek (2002) discovered that speakers specifically oriented their gestures so they were visible depending on where the listeners were seated. Gesturers are also considerate of the listener's state of knowledge producing more gestures and words where common ground is not shared (Clough, & Duff, 2020). Evidently, speakers devise their gestures for the listener to communicate new or vital information, underscoring gesture's communicative function.

### **The facilitative hypothesis**

Despite the wealth of evidence that gestures aid listeners in better understanding a conversation, advocates of the facilitative hypothesis claim that this is not the main function of gesture. They claim that the evidence suggests gestures are barely comprehensible in the absence of concurrent speech, resulting in the assumption that gesture facilitates the speaker in their internal language processing (Krauss, Chen, & Gottesman, 2000). Some research suggests that gestures contribute little to a listener's comprehension of the speaker's speech (Krauss, Morrel-Samuels, & Colasante, 1991).

Advocates of the facilitative function hypothesis claim that speech production processes, namely lexical retrieval (Krauss, 1998) and conceptualization (Kita, 2000; Kita *et al.*, 2017) evidence the function of gesture as being for the speaker, as well as the following: the timing and duration of gesture (Morrel-Samuels, & Krauss, 1992); gesturing in the absence of a listener (Alibali, Heath, & Myers, 2001); gesturing by blind speakers to blind listeners (Iverson, & Goldin-Meadow, 2001); gesture and speech fluency (Rauscher, Krauss, & Chen, 1996); gesture frequency (Kita, & Davies, 2009); co-thought gesture (Chu, & Kita, 2011); gesture interpretability (Krauss, Morrel-Samuels, & Colasante, 1991); gesture restriction (Cohen, & Borsari, 1996; Morsella, & Krauss, 2004); and the 'tip-of-the-tongue' phenomenon (Jones, & Langford, 1987). The subsequent section will examine the aforementioned evidence, which the facilitative function hypothesis proponents regard as proving their camp of thought to be the prevailing one in the long-running debate as to why people gesture.

### **What the evidence reveals**

This section seeks to analyze the strength of the evidence put forward by the facilitative function hypothesis as a means to answer the question as to why people gesture.

#### **Gesture intelligibility**

Krauss, Morrel-Samuels and Colasante (1991) claim gesture does not have a communicative function as gestures are barely comprehensible in the absence of accompanying speech. However, in light of McNeill's (1992) work, which has continually proven gesture and their accompanying speech form a tightly integrated semantic unit, and the neuroimaging evidence that supports this (Xu *et al.*, 2009), this is an unsound argument. Typically, a listener has simultaneous access to speech and gesture meaning interpretability of gesture is not difficult, hence it can be said to play an essential communicative role.

#### **Gesturing in the absence of a listener**

Speakers often use representational gestures despite knowing they are not visible to the listener, thus the assumption is that representational gestures function is unlikely to be merely communicative (Alibali, Heath, & Myers, 2001). For instance, when talking on the phone, people gesture. The communicative hypothesis's counter-argument has often been that people gesticulate while talking on the telephone, thus evidencing that people do not gesture for the

listener. Proponents of the facilitative hypothesis claim that Alibali, Heath, and Meyers' (2001) study on speakers gesturing in the absence of their interlocutors is evidence that the gestures are for the speaker, not the listener, thus evidencing that the function of gesture is to facilitate cognitive process in speech production (Hostetter, & Alibali, 2004). However, as Kendon (1994) has argued we could assume that people do so more out of habit than for any other reason. Certainly, in terms of human evolution, telephone use, as a communicative tool, is a very recent invention. The fact that people gesture while on the telephone is perhaps more indicative of gesturing being deeply integrated with speech production (McNeill, 1992; Xu *et al.*, 2009). This in mind, the sheer fact that people gesture while talking on the telephone is insufficient evidence of gesture being facilitative in function.

### **Gesture among blind speakers**

Congenitally blind speakers gesture, even when talking to blind listeners (Iverson, & Goldin-Meadow, 2001). The visible 'absence' of their interlocutors is claimed as evidence that gesture may function more to facilitate a speaker's internal language processing, thus are for the speaker, not the listener. As a result, researchers have suggested that gesture has an unequivocal function in the speech production process, and that rather than being superfluous to speech, it actually complements and aids in the structuring of speech. Iverson and Goldin-Meadow (2001) found all participants, sighted or blind, gesticulated regardless of the listener's visual ability, which in line with other research suggests that the absence or presence of a listener is irrelevant. This evidence seems to further support McNeill's position that gesture and its accompanying speech form a tightly integrated semantic unit.

### **Lexical retrieval**

The Lexical Access Hypothesis (LAH) (Krauss, 1998) posits that gesture aids in accessing the mental lexicon, especially words with spatial content (Rauscher, Krauss, & Chen, 1996). In line with Levelt's speech production model, more specifically the phonological encoder level, in which words' phonological configuration is organized for elocution, Krauss, Chen and Gottesman (2000) submit that the facilitative effect of gesture occurs there. However, how precisely producing iconic/lexical gestures enable a speaker to extract the phonological word form has yet to be explained. LAH suggests that cross-modal priming (derived from tip-of-the-tongue research) through iconic or lexical gesture (being representative of a universal semantic aspect of the target word, such as gesturing long ears to retrieve the word 'rabbit') intensifies neural activation making lexicon retrieval easier (Krauss, Chen, & Gottesman, 2000).

Chawla and Krauss (1994) argue that gesturing plays a role in speech production by facilitating lexical retrieval. They maintain that individuals gesture more when lexical retrieval becomes more challenging like incidences of spontaneously speaking or eliciting things from memory (Morsella, & Krauss, 2004), evidencing gesture's role in speech production. Morrel-Samuels and Krauss (1992) found that the onset of gesture typically comes before the word it is accompanying. Additionally, the interval duration increases with the unfamiliarity of the word. The belief is that the temporal nature of speech and gesture indicates that gesture

facilitate lexical retrieval. Conversely, however, other research findings are that gesture ceases when speech does (Graziano, & Gullberg, 2018), which challenges the assumptions that gesture has a predominantly lexical complementary role. These findings further present strong confirmation that speech and gesture form a tightly integrated system of communication.

Moreover, as de Ruiter (2003) counters, before generating an iconic/lexical gesture, spatial properties of the concept to be gestured about need to be converted from the brain into manual action. In other words, the information required for the purposes of generating the correct motor program for the gesture is already available before lexical retrieval is even initiated. It would be a rather inefficient process for our internal language processing system to first encode information into gesture to then decode the spatial properties from its own generated gesture by means of 'kinesthetic self-awareness back into visual features when it already had access to the spatial features' (de Ruiter, 2003: 341).

### **Conceptualization**

There is data that submits that gesture enables the planning and organization of utterances. Derived from McNeill's (1992) Growth Point Theory, the Information Packaging Hypothesis (IPH) (Kita, 2000), theorizes that gesture aids in conceptualization by allowing the speaker to bundle visuospatial information into units which correspond to the speech.

Hostetter and Alibali (2004) tested LAH and IPH in the role of gesture in speech production by having participants describe dot patterns which varied in conceptual difficulty in terms of geometric form. Noticeably, participants gestured more where patterns were challenging to conceptualize. The authors found that this supported IPH, but also acknowledge that gesture both aids lexical retrieval and planning speech for articulation. Other research supports the notion of IPH in that the propensity to gesture increases where the demands on processing are more difficult and there are more linguistic challenges (Kita, & Davies, 2009). This evidence corroborates the assertion that gesture functions, for thinking and speaking, to package spatio-motoric information.

### **Gesture-restriction**

Logically, the most direct way of investigating the facilitative function hypothesis is to prevent speakers from gesturing and determine its effects. Gesture-restrictions placed on speakers have shown to have a direct impact on speech production: people exhibit less fluency and increased pauses (Rauscher, Kauss, & Chen, 1996). Cohen and Borsoi's (1996) study established that gesture-restriction increased the amount of time required to describe an object. Similarly, gesture-restriction generally reduces speech rate in description tasks (Morsella, & Krauss, 2004). The conclusion made is that gesture facilitates lexical retrieval access, due to the effects of gesture-restriction being similar to challenges of word-finding.

However, in light of the evidence that gesture modality is considerably more effectual in communicating spatial information, the loss of fluency in gesture-restriction is arguably foreseeable. This fluency-deficit does not occur where the speech content is not spatial. Therefore, it seems this claim that gesture facilitates lexical retrieval is somewhat unfounded. Furthermore, one could argue that the speaker is merely distracted by the prohibition on



movement, hence the pausing.

### **Tip-of-the-tongue phenomenon**

'Tip-of-the-tongue' studies have discovered that challenges in word retrieval are often phonological related rather than semantic (Jones, & Langford, 1987). Furthermore, where gesture is restricted individuals undergo word retrieval failures (see section 3.6). The 'tip-of-the-tongue' phenomenon as when a speaker is unable to access the mental lexicon but there is a sense of knowing the language item being searched for. When retrieval failure occurs, the speaker is unable to access whole information regarding the target word.

Beattie and Coughlan (1999) induced a 'tip-of-the-tongue' state in participants to test LAH. The researchers permitted half of the participants to gesture but put gesture-restrictions on the other half by having them fold their arms. Participants then listened to definitions followed by words and were asked to indicate which of the words the definition described. The finding was that gesture actually lowered the probability of ending the 'tip-of-the-tongue' state, which greatly challenges the claims made by LAH.

Similarly, other research findings are that speakers gesture more during fluent than tongue-tied speech (Mayberry, & Jaques, 2000), implying that the function is not facilitative, but rather it functions as co-speech. The empirical evidence that supports the facilitative hypothesis does in fact support the theory that gesturing 'is a communicative device which is compensating for problems in speech by providing information in another channel.' (de Ruiter, 2003: 338).

### **Co-thought gesture**

Chu and Kita (2011) conducted a mental rotation task and discovered that participants in solving the problem extemporaneously gesticulated in the air like they were actually turning objects with their hands, even when alone. The authors argue that these co-thought gestures (as opposed to co-speech gestures) corroborate the notion that gesture aids the speaker in thinking and lacks any communicative function. This is indeed a compelling piece of evidence that gesture has a facilitative function.

## **Discussion**

While the evidence demonstrates that there may be a facilitative function in gesturing, it does not fully explain all the gesture roles as laid out in this paper in section 2.2., nor the precise ways in which lexical retrieval and conceptualization processes actually occur in the brain. In time, however, future neuroimaging research may support and further evidence these theories just as researchers have identified that gesture processing occurs in the same parts of the brain (Broca's and Wernicke's areas) used by speech and sign language (Xu *et al.*, 2009), supporting McNeill's (1992) notion that gesture and spoken language are both part of a solitary semiotic system that underscores human communication.

Gesture research clearly demonstrates that gestures have not only a facilitative function but also a communicative function. The evidence suggests that gesture does not only actively



aid comprehension, learning and memory, and facilitate the cognitive processes of speech production, but also provides vital information to an utterance for both the speaker and the listener. Research has found that speakers design their utterances specifically for the listener and that, in addition, in certain contexts they intend for their gestures to be communicative.

Moreover, where the function of gesturing may be to access the mental lexicon then that arguably falls under the notion of it being a communicative device in that without access to the word that a person needs to communicate themselves then communication may not be possible. This reasoning suggests that gesturing is both facilitative and communicative. Where the evidence for one viewpoint does not explain other phenomena then perhaps it is because both viewpoints are perfectly and equally valid explanations regarding the exact nature of the function of gestures.

Numerous researchers mentioned in this paper acknowledge that gestures may undoubtedly be multifunctional, fulfilling various communicative and facilitative functions. I would suggest that rather than viewing gestures in terms of 'functions,' perhaps we would be better served by classifying gestures into two categories; communicative gestures and facilitative gestures. This classification could potentially address the ongoing debate and allow for a new approach to investigating and understanding the function of gesture in its entirety.

### Conclusion

This paper has sought to examine the empirical evidence that supports the facilitative hypothesis in order to determine how that evidence answers the question as to what the function of gesture is. Gesture is fundamental to human communication, tightly integrated with speech in the conceptualization, construction and perception of words, and frequently conveys unique information absent in speech modality, specifically in relation to spatial and motoric properties of that which is being referred to. Speech and gesture modalities work together to augment the language context. One could posit that just as speech and gesture are inextricably connected, so are the facilitative and communicative functions of gesture in human communication.

In order to more thoroughly comprehend the functional aspects and processes of gesture, for both speaker and listener, there is a need to conduct more investigative studies of various communicative contexts across many languages, the speakers' gestural intention, the individual propensity to gesture, as well as more development and neuroimaging studies. It would be increasingly valuable to examine under which situations gestures fulfil what class of functions, and in what way different cognitive processes, that are central to human communication, have bearing on gesture use. As a result, both camps may come to view gesture as having a multitude of functions rather than a solitary function, given the variance of gesture in the different contexts in which it occurs.

## References

- Alibali, M. W., Heath, D. C., & Myers, H. J. (2001). Effects of visibility between speaker and listener on gesture production: some gestures are meant to be seen. *Journal of Memory and Language*, 44(2), 169–188. <https://doi.org/10.1006/jmla.2000.2752>
- Beattie, G., & Coughlan, J. (1999). An experimental investigation of the role of iconic gestures in lexical access using the tip-of-the-tongue phenomenon. *British Journal of Psychology*, 90(1), 35–56. <https://doi.org/10.1348/000712699161251>
- Beattie, G., & Shovelton, H. (2000). Iconic hand gestures and the predictability of words in context in spontaneous speech. *British Journal of Psychology*, 91(4), 473–491. <https://doi.org/10.1348/000712600161943>
- Cassell, J., McNeill, D., & McCullough, K. (1999). Speech-gesture mismatches: Evidence for one underlying representation of linguistic a nonlinguistic information. *Pragmatics and Cognition*, 7(1), 1–34. <https://doi.org/10.1075/pc.7.1.03cas>
- Chawla, P., & Krauss, R. M. (1994). Gesture and speech in spontaneous and rehearsed narratives. *Journal of Experimental Social Psychology*, 30(6), 580–601. <https://doi.org/10.1006/jesp.1994.1027>
- Chu, M., & Kita, S. (2011). The nature of gestures' beneficial role in spatial problem solving. *Journal of Experimental Psychology: General*, 140(1), 102–116. <https://doi.org/10.1037/a0021790>
- Clough, S., & Duff, M. C. (2020). The Role of Gesture in Communication and Cognition: Implications for Understanding and Treating Neurogenic Communication Disorders. *Frontiers in Human Neuroscience*, 14, 1–22. <https://doi.org/10.3389/fnhum.2020.00323>
- Cohen, R. L., & Borsoi, D. (1996). The role of gestures in description-communication: A cross-sectional study of aging. *Journal of Nonverbal Behavior*, 20, 45–63. <https://doi.org/10.1007/BF02248714>
- Dargue, N., Sweller, N., & Jones, M. P. (2019). When our hands help us understand: a meta-analysis into the effects of gesture on comprehension. *Psychological Bulletin*, 145(8), 765–784. <https://doi.org/10.1037/bul0000202>
- de Ruiter, J. P. (2000) The Production of gesture and speech. In: McNeill, D. (ed.) *Language and Gesture*. Cambridge, Cambridge University Press, 284–311.
- de Ruiter, J. P. (2003) How the Hands Function in Spoken Conversation. In: Birchenbank, M., Klappert, A., & Pompe, H. (eds.) *Manus Loquens*. Cologne, DuMont, 338–347. [https://pure.mpg.de/rest/items/item\\_57658/component/file\\_57659/content](https://pure.mpg.de/rest/items/item_57658/component/file_57659/content)
- de Ruiter, J. P. (2017). The asymmetric redundancy of gesture and speech. In: Church, R. B., Alibali, M. W., & Kelly, S. D. (eds.) *Why Gesture? How the Hands Function in Speaking, Thinking, and Communicating*. Amsterdam: John Benjamins Publishing Company, 59–75.
- Feyereisen, P., & de Lannoy, J. D. (1991). *Gestures and Speech: Psychological Investigations*. New York: Cambridge University Press.
- Graziano, M., & Gullberg, M. (2018). When Speech Stops, Gesture Stops: Evidence From Developmental and Crosslinguistic Comparisons. *Frontiers in Psychology*, 9, 879, <https://doi.org/10.3389/fpsyg.2018.00879>
- Hostetter, A. B., & Alibali, M. W. (2004). On the Tip of the Mind: Gesture as a Key to Conceptualization. *Journal Proceedings of the Annual Meeting of the Cognitive Science Society*, 26(26), 589–594. <https://escholarship.org/uc/item/0bq3923m>
- Hostetter, A. B., & Alibali, M. W. (2008). Visible embodiment: gestures as simulated action. *Psychonomic Bulletin & Review*, 15(3), 495–514. <https://doi.org/10.3758/pbr.15.3.495>
- Hostetter A. B., & Alibali, M. W. (2010). Language, gesture, action! A test of the Gesture as Simulated Action framework. *Journal of Memory and Language*, 63(2), 245–257. <https://doi.org/10.1016/j.jml.2010.04.003>
- Hostetter, A. B., & Skirving, C. J. (2011). The effect of visual vs. verbal stimuli on gesture production. *Journal of Nonverbal Behavior*, 35, 205–223. <https://doi.org/10.1007/s10919-011-0109-2>
- Hostetter, A. B., & Alibali, M. W. (2019). Gesture as simulated action: Revisiting the framework. *Psychonomic Bulletin & Review*, 26(3), 721–75. <https://doi.org/10.3758/s13423-018-1548-0>
- Iverson, J. M., & Goldin-Meadow, S. (1998). The resilience of gesture in talk: gesture in blind speakers and listeners. *Developmental Science*, 4(4), 416–422. <https://doi.org/10.1111/1467-7687.00183>
- Jones, G. V., & Langford, S. (1987). Phonological blocking in the tip of the tongue state. *Cognition*, 26(2), 115–122. [https://doi.org/10.1016/0010-0277\(87\)90027-8](https://doi.org/10.1016/0010-0277(87)90027-8)
- Kelly, S. D., Barr, D. J., Breckinridge Church, R., & Lynch, K. (1999). Offering a hand to pragmatic understanding: The role of speech and gesture in comprehension and memory. *Journal of Memory and Language*, 40(4), 577–592. <https://doi.org/10.1006/jmla.1999.2634>
- Kendon, A. (1994). Do Gestures Communicate?: A Review. *Research on Language and Social Interaction*, 27(3), 175–200. [https://doi.org/10.1207/s15327973rlsi2703\\_2](https://doi.org/10.1207/s15327973rlsi2703_2)
- Kendon, A. (2004). *Gesture: Visible action as utterance*. Cambridge, UK: Cambridge University Press.
- Kita, S. (2000). “How representational gestures help speaking,” in McNeill, D. (Ed.) *Language and Gesture. Language Culture and Cognition*. Cambridge: Cambridge University Press, 162–185.
- Kita, S., & Davies, T. S. (2009). Competing conceptual representations trigger co-speech representational gestures,

- Language and Cognitive Processes*, 24(5), 761–775. <https://doi.org/10.1080/01690960802327971>
- Kita S., Alibali, M. W., & Chu, M. (2017). How do gestures influence thinking and speaking? The gesture-for-conceptualization hypothesis. *Psychology Review*, 124(3), 245–266. <http://dx.doi.org/10.1037/rev0000059>
- Krauss, R. M. (1998). Why Do We Gesture When We Speak? *Current Directions in Psychological Science*, 7(2), 54–54. <https://doi.org/10.1111/1467-8721.ep13175642>
- Krauss, R. M., Morrel-Samuels, P., & Colasante, C. (1991). Do conversational hand gestures communicate? *Journal of Personality and Social Psychology*, 61(5), 743–754. <https://doi.org/10.1037/0022-3514.61.5.743>
- Krauss, R. M., Chen, Y., & Chawla, P. (1996). Nonverbal Behavior and Nonverbal Communication: What do Conversational Hand Gestures Tell Us? *Advances in Experimental Social Psychology*, 28, 389–450. [https://doi.org/10.1016/S0065-2601\(08\)60241-5](https://doi.org/10.1016/S0065-2601(08)60241-5)
- Krauss, R. M., Chen, Y., & Gottesman, R. F. (2000). Lexical Gestures and Lexical Access: A Process Model, in *Language and Gesture by D. McNeill (Ed.)*. New York: Cambridge University Press, 261–283.
- McNeill, D. (1992). *Hand and Mind: What Gestures Reveal about Thought*. Chicago: University of Chicago Press.
- Mayberry, R. I., & Jaques, J. (2000). “Gesture production during stuttered speech: insights into the nature of gesture-speech,” in McNeil, D. (Ed.) *Language and Gesture. Language Culture and Cognition*. Cambridge: Cambridge University Press, 199–214.
- Morrel-Samuels, P., & Krauss, R. M. (1992). Word familiarity predicts temporal asynchrony of hand gestures and speech. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 18(3), 615–623. <https://doi.org/10.1037/0278-7393.18.3.615>
- Morsella, E., & Krauss, R. (2004). The Role of Gestures in Spatial Working Memory and Speech. *The American Journal of Psychology*, 117(3), 411–424. <https://doi.org/10.2307/4149008>
- Özyürek, A. (2002). Do Speakers Design Their Cospeech Gestures for Their Addressees? The Effects of Addressee Location on Representational Gestures. *Journal of Memory and Language*, 46(4), 688–704. <https://doi.org/10.1006/jmla.2001.2826>
- Rausher, F., Krauss, R. M., & Chen, Y. (1996). Gesture, speech and lexical access: The role of lexical movements in speech production. *Psychological Science*, 7(4), 226–231. <https://doi.org/10.1111/j.1467-9280.1996.tb00364.x>
- Valenzeno, L., Alibali, M. W., & Klatzky, R. (2003). Teachers’ gestures facilitate students’ learning: a lesson in symmetry. *Contemporary Educational Psychology*, 28(2), 187–204. [https://doi.org/10.1016/S0361-476X\(02\)00007-3](https://doi.org/10.1016/S0361-476X(02)00007-3)
- Warren, P. (2013). *Introducing Psycholinguistics*. Cambridge: Cambridge University Press.
- Xu, J., Gannon, P. J., Emmorey, K., Smith, J. F., & Braun, A. R. (2009). *Symbolic gestures and spoken language are processed by a common neural system*. Proceedings of the National Academy of Sciences of the United States of America. 106(49), 20664–20669. <https://doi.org/10.1073/pnas.0909197106>