Temporal overlap between gestures and speech in post-stroke aphasia: Is there a compensatory effect?

Han Zhang[1], *Wolfram Hinzen*[1,2]

[1] Department of Translation and Language Sciences, Universitat Pompeu Fabra, Barcelona, Spain

[2] Catalan Institute for Advanced Studies and Research (ICREA), Barcelona, Spain

han.zhang@upf.edu

If language production is impaired, will gestures compensate? Evidence in favor of this prediction has often been argued to come from aphasia, but remains contested. Here we tested whether thought content not present in speech due to language impairment can be manifest in gesture, in 20 people with dysfluent (Broca's) aphasia (PWBA), 20 with fluent (Wernicke's) aphasia (PWWA), and 20 matched neurotypical controls. A new annotation scheme was created distinguishing types of gestures and whether they co-occurred with fluent or dysfluent/absent speech, and were temporally aligned in content with co-produced speech. Specifically, annotation proceeded by first identifying gestures and then classifying them as either content gestures or not. Content gestures were subdivided as descriptive, referential, metaphorical or content-unclear. The remaining gestures that did not fall into this category mainly include emblems, pantomimes, beat and unidentifiable gestures. When the type of a gesture was identified as 'Content', we subsequently analyzed it with respect to whether it temporally overlapped with the production of speech or not. If the content gesture was produced with no accompanying speech, "No speech" would be annotated. If, on the other hand, there was a temporal overlap, we then determined whether the accompanying speech was fluent or dysfluent. If it was fluent, we determined whether the speech and gesture were aligned in content or not. "Fluent-aligned" would be annotated if both speech and gesture expressed similar meaning. Otherwise, "Fluent-nonaligned" would be coded (i.e., gesture conveyed content different from that of speech). In cases where the accompanying speech was dysfluent, "Dysfluency" would be coded. If a referential gesture was coproduced with fluent speech, which was further aligned in content with the accompanying speech, we checked whether the referent could be understood from the context or not. For example, when a referential gesture was coproduced with a pronoun without an antecedent and whose referent could not be determined, "Referential anomaly" would be coded. If the accompanying speech was annotated as "dysfluent," we further checked whether the given dysfluency was eventually resolved or unresolved, that is, whether the target word was successfully retrieved or not (Table 1 lists the composite variables generated from the above scheme and analyzed for each participant. Figure 1 summarizes the flow of the annotation process). Results showed that across both aphasia types, non-content (beat) gestures, which by their nature cannot compensate for lost speech content, constituted the greatest proportion of all types of gestures produced. Moreover, content gestures were largely co-produced with fluent rather than dysfluent speech, and tended to be aligned with the content conveyed in speech. They also did not differ in quantity, depending on whether the dysfluencies were eventually resolved or not. Neither aphasia severity nor comprehension ability had an impact on the total amount of content gesture produced in PWA, which was instead positively correlated with speech fluency. Together, these results suggest that gestures are unlikely to have a role in compensating for linguistic deficits and to serve as a representational system conveying thought content independent of language. Surprisingly, aphasia rather is a model of how gesture and language are inherently integrated and aligned: even when language is impaired, it remains the essential provider of content.

Index Terms: Gesture, Speech, Aphasia, Compensatory effect

Table 1. A summary of the composite variables investigated.

Composite variables	Abbreviations
Content gestures that were co-produced with fluent speech.	Content-fluent
Descriptive gestures that were co-produced with fluent speech.	Descriptive-fluent
Referential gestures that were co-produced with fluent speech.	Referential-fluent
Content gestures that were co-produced with fluent speech and aligned in content with the accompanying speech.	Content-fluent-aligned
Descriptive gestures that were co-produced with fluent speech and aligned in content with the accompanying speech.	Descriptive-fluent-aligned
Referential gestures that were co-produced with fluent speech and aligned in content with the accompanying speech.	Referential-fluent-aligned
Referential gestures that were co-produced with fluent speech and contained an anomaly shared by both gesture and speech.	Content-referential anomaly
Content gestures that were co-produced with fluent speech and nonaligned in content with the accompanying speech	Content-fluent-nonaligned
Content gestures that were produced with dysfluencies or in the absence of speech	Content-dysfluency-no speech
Descriptive gestures that were produced with dysfluencies or in the absence of speech	Descriptive-dysfluency-no speech
Referential gestures that were produced with dysfluencies or in the absence of speech	Referential-dysfluency-no speech
Content gestures that were co-produced with dysfluencies that were resolved	Content-dysfluency-resolved
Content gestures that were co-produced with dysfluencies that were unresolved	Content-dysfluency-unresolved

Figure1. A schematic representation of the annotation scheme.