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Experimental approaches to studying visible meaning

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Schlenker provides compelling linguistic evidence that iconic phenomena in sign languages play a crucial role in semantic interpretation, and he draws clear parallels between iconic phenomena expressed by co-speech gesture and by signs. Schlenker ends his paper by considering whether iconicity and grammar should be treated as two separate modules that interact or as a single module. Schlenker favors a one-module theory due to the non-trivial interaction between grammar and iconic phenomena in sign language and possibly between co-speech gesture and grammar in spoken languages (more research is needed in this domain). For a two-module theory to succeed, Schlenker argues that criteria defining a module need to be developed in order to identify grammatical phenomena in sign language that exclude iconicity. Experimental work might be useful in this endeavor by providing data on how iconic and grammatical phenomena are processed and represented.

For example, gradience (or “quasi-gradience” as suggested by Schlenker, given the perceptual/motoric limitations of humans) is a property that is much more likely to be associated with iconic than grammatical phenomena. As mentioned by Schlenker, Emmorey and Herzig (2003) conducted an experiment showing that signers both interpreted and produced (in a picture-description task) the spatial location of a small object classifier handshape in a gradient rather than categorical manner (i.e. spatial locations were not grouped together in spatial categories like *above*, *under*, etc.). In contrast, although deaf signers interpreted gradient changes in a classifier handshape as indicating gradient changes in the size of a round object (a medallion at the end of a necklace), they did not modify the classifier handshape in a gradient manner when asked to describe a single picture of the medallion. Rather, one of three handshape morphemes was chosen to indicate a small, medium, or large size. Sevcikova Sehyr and Cormier (2016) recently showed that deaf signers exhibited stronger category boundary effects when identifying handling classifier handshapes compared to hearing non-signers, although their reaction times on a discrimination task also suggested gradient organization within a category (with hand-shape prototype grounding the category). Such classifier signs (as well as pronominal signs) could be argued to be at the interface between grammatical (categorical) and iconic (gradient) representations.

In contrast to such forms, I suggest that many lexical signs are of necessity interpreted and produced categorically, unless the signer intentionally exploits the iconic features of the sign (and the two modules thus interact). That is, gradient variations in the form of a lexical sign

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are not generally interpreted as meaningful because the language comprehension system must be able to generalize across individual and contextual variation to recognize signs. For example, the ASL sign BIRD is produced by tapping the thumb and index finger together at the mouth. The exact location of the hand at the mouth, the speed of the tapping movement, and the size of the movement are likely to vary across signers and across contexts (e.g. signing fast or slow). The comprehension system must be able to rapidly recognize all of these various productions of the same lexical item, BIRD. Nonetheless, a signer can (optionally) exploit the gradient iconicity of the form by, for example, producing a large or small movement to convey the idea of a large or a small bird. Again, this type of production is where the two modules interact. This example is parallel to the (optional) use of vocal gesture in spoken language, such as saying “tiny bird” in a high pitched voice to vocally depict a small size. Further experimental research investigating whether, when, and how gradient aspects of sign form are interpreted and/or expressed could illuminate whether gradient or analog properties can be used to define two modules within the language system, as well as whether such a modular division is useful.

Neuroimaging studies can also shed light on these questions. For example, Emmorey et al. (2013) used Positron Emission Tomography (PET) to investigate the neural substrates supporting the production of locative classifier constructions in ASL. These constructions were similar to those studied by Emmorey and Herzig (2003) in that the classifier handshape indicates object type (e.g. flat and round; long and thin) and the location of the hand gradiently depicts the location of a referent object. In this PET study, deaf signers performed a picture-description task in which they overtly named objects with lexical signs or produced classifier constructions that varied in location (e.g. a clock in many different spatial configurations with respect to a table) or categorically with respect to object type (e.g. different objects, each located on top of the table). In contrast to the expression of gradient locations, the production of both lexical signs and object type classifier morphemes activated language-related cortices (left inferior frontal gyrus and left inferior temporal cortex). This result supports the hypothesis that classifier handshapes are categorical morphemes which are retrieved via left hemisphere language regions. In contrast to the production of lexical signs, the production of classifier constructions expressing spatial locations engaged regions in bilateral superior parietal cortex. These parietal regions are known to be involved in the on-line control of reaching movements and in visual-spatial attention. Emmorey et al. (2013) argued these parietal functions were engaged because the signer’s hand must move to specific locations in front of the body to iconically depict gradient spatial locations. These locations are not stored as morphemic representations within language cortex, in contrast to lexical signs and classifier handshape morphemes. The finding that different components of locative classifier constructions are under differential neural control could be argued to support the two-module hypothesis.

Psycholinguistic studies are also useful for investigating how iconic variables are interpreted. For example, probe recognition paradigms have been exploited to investigate anaphora resolution and pronoun processing in signed and spoken languages. Emmorey and Falgier (2004) used this method to investigate what they termed *locus doubling* in which a single referent is associated with two distinct locations in signing space, a phenomenon that is parallel to Schlenker’s notion of *locative shift*. The experiment explored whether an ASL

pronoun activates both its antecedent referent and the location associated with that referent. Deaf signers viewed an introductory sentence that introduced a referent (e.g. MY WONDERFUL MOTHER B-U-S-Y; “My wonderful mother is very busy”) followed by sentences describing two distinct locations (e.g. WENT-TO STORE_{left} BUY_[iterative] FOOD, FINISH. _{left}BRING_{right} KITCHEN_{right} PREPARE; “She went to the store and shopped for food. Then she brought it to her kitchen where she prepared it”). Two possible continuation sentences followed that either contained a pronoun referring to the referent in one location (e.g. HAPPEN PRONOUN_{left} FORGOT BUY ONION; “As it happens, she forgot to buy onion (while she was at the store)”) or contained no pronoun (e.g. HAPPEN WILL BIG DINNER GATHERING; “As it happens there will be a big get-together for dinner”). Participants made lexical decisions to probe signs presented during the continuation sentences. Crucially, the probe signs (“yes” responses) were either the referent of the pronoun (e.g. MOTHER), the referent location determined by the pronoun (e.g. STORE), or the most recently mentioned location not referenced by the pronoun (e.g. KITCHEN). Response times to referent nouns were faster in the pronoun condition than in the no-pronoun control condition, indicating that the pronoun “re-activated” its antecedent, making this noun more accessible and thus speeding lexical decision times. However, response times to the location signs did not differ across conditions. Emmorey and Falgier (2004) concluded that pronouns activate only referent nouns, not spatial location nouns associated with the referent.

However, Emmorey and Falgier’s (2004) conclusion might only hold when the pronoun is ambiguous between referring to an individual and a location or when the individual interpretation remains topical in the continuation. Schlenker (personal communication; March, 2017) suggested one way to test this hypothesis would be to include a continuation in which the pronoun referring to the individual is directed toward neutral space, i.e. not toward the location associated with the store (or the kitchen), perhaps also adding an explicit anaphoric reference that makes the distinction between the location and the individual clear (e.g. HAPPEN THERE_{left} PRONOUN_a FORGOT BUY ONION; “As it happens, at the store she forgot to buy onion”). In this case, the prediction is that response times will be faster to both the individual referent (MOTHER) and the location referent (STORE), in comparison to the no-pronoun control continuation (as long as the probe sign is presented after the relevant pronoun). The general point here is that psycholinguistic paradigms that have been used to explore pronoun resolution might be quite useful in exploring how signers interpret iconic variables in real time. The results from Emmorey and Falgier (2004) suggest that the on-line co-reference processing mechanism is most sensitive to the relation between a pronoun and its antecedent, rather than between the pronoun and other nominals associated with the indexed location in signing space.

Other psycholinguistic studies indicate that if the location associated with a referent is imbued with meaning then signers are more likely to remember the association between the referent and that location. For example, Emmorey et al. (1995) conducted a “continuous memory” experiment in which participants were shown ASL sentences and had to decide for each sentence whether it had been seen before or not. The experimental sentences either associated referents with relatively arbitrary locations in space (no semantic relation among the locations) or with locations that functioned to convey topological (spatial) information,

e.g. the layout of different tools on a work bench. In the memory study, some sentences were altered by reversing the spatial locations associated with two referents. Participants were much more likely to notice this alteration (i.e. indicate that the sentence was new rather than old) when the locations carried semantic (topological) information. Thus, locations that convey specific information about the location of their associated referents appear to be better encoded and maintained in memory, perhaps as part of a semantic representation. In contrast, locations that function primarily to distinguish among referents may not be encoded in the same way and may be more likely to fade from memory once their referential function is no longer required by the discourse.

In sum, experimental studies of how signers interpret, produce, and encode iconic phenomenon in sign languages are likely to be beneficial to answering some of the questions raised by Schlenker's target article. The value of such an approach will also be heightened to the extent that experimental paradigms can be extended to include co-speech gesture for spoken languages (e.g. how co-speech gestures are used to interpret ambiguous pronouns; Smith and Kam 2012).

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