

DISSERTATION ABSTRACT

The role of iconicity and simultaneity in efficient communication in the visual modality

Evidence from LIS (Italian Sign Language)

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Anita Slonimska

Max Planck Institute for Psycholinguistics

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Sign languages share the same fundamental linguistic properties as spoken languages at all levels of linguistic organization (Sandler & Lillo-Martin 2006). However, they also exhibit modality-specific features, i.e., the ability to convey information iconically and simultaneously. Recent research has shown that the iconic and simultaneous properties of sign languages constitute a more central role than previously thought in language structuring, processing, and learning (Perniss et al. 2010; Vermeerbergen et al. 2007). The dissertation summarized in the current abstract goes beyond existing literature by systematically investigating these visual modality-specific properties from a new perspective, i.e., efficient communication.

Recently, it has been proposed that one of the fundamental functions of language is to allow efficient communication, that is, “easy, fast and robust information transmission” (Gibson et al. 2019: 389), thereby finding a balance between minimizing costs in language production and comprehension (Gibson et al. 2019; Grice 1975; Levshina & Moran 2021). A substantial amount of evidence suggests that communicative efficiency constitutes one of the selective pressures that drives cultural language evolution, and it might explain several aspects of language structure cross-linguistically (for a review, see Gibson et al. 2019; Levshina 2022). One of the ways how linguistic systems optimize for communicative efficiency is by positioning syntactically and semantically related elements closer together in a sentence, thereby lightening memory load during language production and comprehension (for a review, see Temperley & Gildea 2018). While this principle has

been attested in a variety of spoken languages, it remains unexplored in sign languages, where the distinct affordances of the visual modality may influence how this principle may be operationalized.

The dissertation explores the hypothesis that the ability of sign languages to organize information simultaneously and iconically is employed for communicative efficiency by allowing for syntactically and semantically related elements of an event to be arranged closer together not only sequentially but also simultaneously (for an example, see Figure 1). To address this hypothesis, three experimental studies are conducted that investigate the use of simultaneous and iconic constructions from different but complementary perspectives in terms of their role in information organization, linguistic encoding strategies, and language evolution. Such an interdisciplinary approach not only allows some of the missing gaps in the literature to be filled, but on a more general scale, it provides a more complete understanding of how language can be optimized for communicative efficiency based on the modality in which it is realized.



Figure 1. An example of simultaneous and iconic construction used to depict a dog holding and petting a bird. The dog is mapped onto the body of the signer and marked by torso, head, facial expression, and eye gaze. The dog's holding action is depicted on the left hand and the petting action is depicted on the right hand. *Note.* Before depicting the dog and its actions, the referents (dog and bird) are introduced via lexical signs

Context of the work

Data reported in the dissertation was collected from 23 deaf adult signers of Italian Sign Language (LIS) and 23 hearing speakers of Italian. Deaf participants completed the task in LIS, while hearing participants completed the task by not using any speech but only their body and gestures (i.e., *silent gesture* paradigm, see Goldin-Meadow et al. 2008). Chapters 2 and 3 are based on the LIS data, and Chapter 4 is based on the comparison between LIS and silent gesture data. All three empirical chapters of the dissertation use the same experimental design but target different perspectives of the investigation. The study reported in Chapter 2 focuses on whether the simultaneous organization of information is used for communicative efficiency in LIS (information organization perspective); the study reported in Chapter 3 focuses on linguistic strategies that are recruited for communicative efficiency in LIS (linguistic encoding perspective); finally, the study reported in Chapter 4 focuses on whether simultaneous and iconic constructions constitute an emergent linguistic property as opposed to simply a general affordance of the visual modality (language evolution perspective).

Methodology

For all three empirical studies, an experiment was designed specifically for the present dissertation to target the use of simultaneous and iconic constructions in an interactive context which requires participants to be communicatively efficient as the information load increases. The design of the experiment consisted of the systematic manipulation of the information density (quantified as the number of semantic information units) of an event involving two animate referents represented in black-and-white images (see Figure 2). There were six different referent pairs in total, and each pair was represented at all five information density levels, yielding 30 images in total.

Each participant played a *director-matcher* game. Participants were asked to describe images appearing on the TV screen to a matcher, so that the matcher (a confederate) could choose the correct image on the laptop. All images were displayed in a semi-randomized order and were not visible to the matcher. Deaf participants were asked to use LIS, and hearing participants were asked to use only their gestures and no speech to describe the images. The participants' productions were video-recorded and used for coding and analyses.

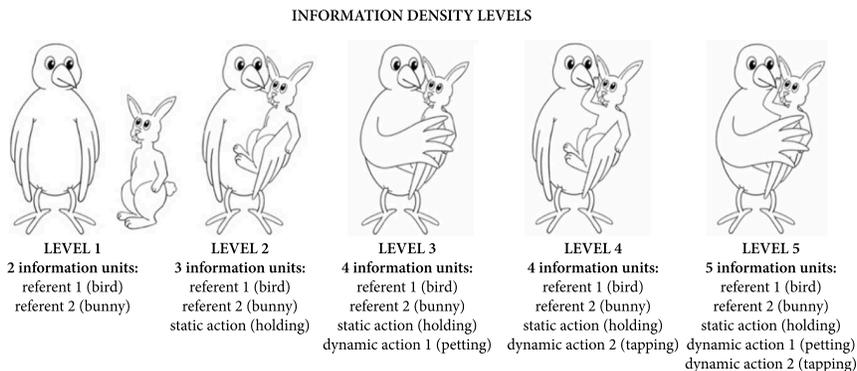


Figure 2. Example of five *Information density levels* for the referent pair: Bird and bunny. The format of the images in levels 1 and 2 is PNG, while the format of the images in levels 3, 4, and 5 is GIF. In the GIFs, the dynamic action of the referents is animated. For the original (animated) version of the stimuli, please see: <https://osf.io/g57p2>

Study 1: The role of iconicity and simultaneity in efficient communication (Chapter 2)

Chapter 2 is based on Slonimska, Özyürek & Capirci (2020). This study investigates whether LIS signers use simultaneous organization of information for communicative efficiency in the context of increasing informational demands. Results reveal that as the amount of information that had to be communicated increased, LIS signers also increased the use of simultaneous constructions as well as the information density of these constructions (quantified as the specific number of distinct semantic information units encoded simultaneously). These findings constitute the first evidence that properties that are specific to the visual modality are taken advantage of in a linguistic system to accommodate pressures of communicative efficiency through the simultaneous encoding of information.

Study 2: Using depiction for efficient communication in LIS (Chapter 3)

Chapter 3 is based on Slonimska, Özyürek & Capirci (2021). This study uses the same data as in Chapter 2 and investigates the linguistic strategies used by LIS signers, in particular focusing on the role of the highly iconic strategy *constructed action* and how it is combined with other linguistic strategies (*depicting constructions, lexical signs, pointing*) to achieve communicative efficiency. The aim of Chapter 3 was to reveal whether constructed action, generally considered to be a discourse strategy used in narratives, can also be used outside of narrative contexts and with the function of achieving communicative efficiency. The results of

the study reveal that constructed action was used to a great extent in an experimental setting, indicating that the use of this strategy is not limited to narrative discourse. Results further showed that the use of constructed action on its own and in combination with other linguistic strategies increased as the amount of information requiring encoding increased, indicating that signers recruited the rich iconic potential that such a strategy provides to achieve efficient communication. The present findings highlight the role of constructed action, which historically has been mostly marginalized in the study of language, and put it at the center of linguistic expression in light of its capacity for efficient communication.

Study 3: Simultaneity as an emergent property of efficient communication in language (Chapter 4)

Chapter 4 is based on Slonimska, Özyürek & Capirci (2022). This study approaches the communicative efficiency function of simultaneous and iconic constructions in sign languages from an evolutionary perspective. It investigates whether simultaneous and iconic constructions used by signers constitute a property that has evolved in a linguistic system as an adaptation for communicative efficiency. This question is addressed by comparing the use of simultaneity by the LIS signers analyzed in Chapter 2 to the use of simultaneity by a group of hearing Italian adults with no knowledge of any sign language and who are asked to use only gestures to communicate (i.e., silent gesture). The study investigates quantitative and qualitative differences in terms of how simultaneous and iconic constructions are used by signers, who employ simultaneity and iconicity as part of their linguistic system, and by silent gesturers, whose only option is to use these properties as a general affordance of the visual modality. Results reveal that the simultaneous and iconic constructions used by signers occurred more frequently and were informationally denser than those used by silent gesturers. Furthermore, qualitative analysis shows that while signers employed diagrammatic iconicity to combine multiple related meaning elements in simultaneous constructions, silent gesturers were more limited in their encodings due to relying primarily on imagistic iconicity and representing referents holistically. Taken together, these findings show that the general affordances of the visual modality allow for simultaneous and iconic information representation, but that the use of such representations is considerably more limited when they are not used as part of a linguistic system. These findings are crucial for supporting the hypothesis that simultaneous and iconic constructions are a linguistic resource for communicative efficiency because they show that the increase in the use of such constructions in the face of increasing information load was not simply due to taking advantage of the visual modality but rather due to employing linguistic resources available in LIS. On a

more general scale, the present findings contribute to the existing research on language evolution by shifting attention from the emergence of linear structure to the emergence of simultaneous structure, a line of research we still know very little about.

Conclusion

By bridging the domains of sign languages, communicative efficiency, and language evolution, this dissertation reveals how the linguistic structure of LIS adapts to meet the demands of efficient communication, underscoring the crucial role of the linguistic modality in this process. The main conclusion that can be drawn from the results of the dissertation is that iconicity and simultaneity constitute linguistic properties that have evolved in sign languages and are used for communicative efficiency. Accordingly, the dissertation provides a new avenue for future research to explore communicative efficiency through a lens that takes a broader view of the language faculty in order to account for its full expressive capacity and semiotic diversity. In the concluding chapter of the dissertation, potential theoretical implications and directions for future research are discussed.

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Address for correspondence

Anita Slonimska
Max Planck Institute for Psycholinguistics
Wundtlaan 1
6525, XD Nijmegen
The Netherlands
anita.slonimska@mpi.nl

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