



# Production and comprehension show divergent constituent order preferences: Evidence from elicited pantomime



Matthew L. Hall <sup>a,\*</sup>, Y. Danbi Ahn <sup>b</sup>, Rachel I. Mayberry <sup>c</sup>, Victor S. Ferreira <sup>b</sup>

<sup>a</sup> University of Connecticut, Linguistics, United States

<sup>b</sup> UC San Diego, Psychology, United States

<sup>c</sup> UC San Diego, Linguistics, United States

## ARTICLE INFO

### Article history:

Received 20 August 2012

revision received 17 December 2014

Available online 24 January 2015

### Keywords:

Word order

Production

Comprehension

Pantomime

Gesture

Sign language

## ABSTRACT

All natural languages develop devices to communicate who did what to whom. Elicited pantomime provides one model for studying this process, by providing a window into how humans (hearing non-signers) behave in a natural communicative modality (silent gesture) without established conventions from a grammar. Most studies in this paradigm focus on production, although they sometimes make assumptions about how comprehenders would likely behave. Here, we directly assess how naive speakers of English (Experiments 1 & 2), Korean (Experiment 1), and Turkish (Experiment 2) comprehend pantomimed descriptions of transitive events, which are either semantically reversible (Experiments 1 & 2) or not (Experiment 2). Contrary to previous assumptions, we find no evidence that PERSON-PERSON-ACTION sequences are ambiguous to comprehenders, who simply adopt an agent-first parsing heuristic for all constituent orders. We do find that PERSON-ACTION-PERSON sequences yield the most consistent interpretations, even in native speakers of SOV languages. The full range of behavior in both production and comprehension provides counter-evidence to the notion that producers' utterances are motivated by the needs of comprehenders. Instead, we argue that production and comprehension are subject to different sets of cognitive pressures, and that the dynamic interaction between these competing pressures can help explain synchronic and diachronic constituent order phenomena in natural human languages, both signed and spoken.

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## Introduction

As humans, we communicate with one another in many different ways. Chief among these is language, but language is not always an option, for example, when interacting with strangers in a foreign-language setting, or when separated by distance or soundproof barriers. In these cases, we are most likely to draw on our capacity for communicating through pantomimic gesture. This type of

gesturing, where the hands and body bear the full burden of communication, has the potential to reveal significant clues about how human communication systems work. Because there are no *a priori* rules for how to gesture in these situations, we can observe what people do without instruction or established conventions, and draw inferences from their behavior about the various forces that shape the form of their utterances. These, in turn, have the potential to reveal insights into how nascent communication systems become organized, as in cases of deaf children developing gesture systems with their hearing families (known as homesign), and newly-emerging sign languages. We ultimately argue that pantomimic gesture

\* Corresponding author at: UConn Linguistics, Unit 1145, 365 Fairfield Way, Storrs, CT 06269-1145, United States.

E-mail address: [matthall.research@gmail.com](mailto:matthall.research@gmail.com) (M.L. Hall).

can even reveal factors that influence the structure of spoken languages.

We are not the first to recognize the value of studying pantomimic gesture (sometimes called “silent gesture”; henceforth, “elicited pantomime”); a number of other researchers have also used elicited pantomime to probe various features of human communication (Fay, Arbib, & Garrod, 2013; Fay, Lister, Ellison, & Goldin-Meadow, 2014; Gershkoff-Stowe & Goldin-Meadow, 1998; Gibson, Piantadosi, et al., 2013; Goldin-Meadow, So, Özyürek, & Mylander, 2008; Langus & Nespors, 2010; Meir, Lifshitz, Ilkbasaran, & Padden, 2010). Notably, however, all but one of these studies (Langus & Nespors, 2010) have focused exclusively on pantomime *production*. We therefore know a good deal about the factors that influence the choices that a person is likely to make when given the task of expressing a given meaning in elicited pantomime. However, we know almost nothing about pantomime *comprehension*, or the factors that influence the choices that a person is likely to make when faced with the task of recovering an intended meaning from a pantomimed utterance. It is not uncommon to find assumptions about the factors that might influence a pantomime comprehender; however direct evidence evaluating those assumptions does not currently exist. Our goal in the present experiments is to characterize the cognitive heuristics that are or are not relevant in pantomime comprehension, and relate them to those that have been previously identified in pantomime production.

We focus primarily on constituent order: that is, the order in which agents (typically subjects), actions (typically verbs), and patients (typically objects) are mentioned in a transitive event. Although we adopt the letters S, V, and O as descriptive nomenclature, we do not claim that pantomimed sequences have all of the linguistic features associated with the syntactic positions of subject, verb, and object. We simply find that this nomenclature is more readily comprehensible (especially when abbreviated) than alternatives such as Agent-Action-Patient terminology. For similar reasons, we refer to pantomimed stimuli as sequences rather than sentences.

Previous research with elicited pantomime has revealed two distinct patterns that are cross-culturally and cross-linguistically robust. First, to describe events involving a human agent and a nonhuman patient (henceforth “non-reversible events”), producers are more likely to use subject-object-verb (SOV) order than any other (e.g., MAN BOX PUSH; Gibson, Piantadosi, et al., 2013; Goldin-Meadow, So, et al., 2008; Hall, Ferreira, & Mayberry, 2014; Hall, Mayberry, & Ferreira, 2013; Meir et al., 2010). However, to describe events involving a human agent and a human patient (henceforth “reversible events”), producers reliably avoid using SOV, preferring instead a wide array of alternatives that include both SVO and OSV (e.g., MAN PUSH WOMAN OR WOMAN MAN PUSH; Gibson, Piantadosi, et al., 2013; Hall et al., 2013, 2014; Meir et al., 2010). For example, across the three experiments in Hall et al. (2013), SOV and OV were used on 53% of non-reversible trials, but on only 9% of reversible trials. Meanwhile, OSV showed a different pattern, nearly doubling from 6% non-reversible to 11% of reversible trials. Interestingly, this means that in the

production data, PERSON-PERSON-ACTION sequences were intended as OSV just as often (if not more) than they were to mean SOV. Finally, SVO grew from 20% of non-reversibles to 32% of reversibles.

Some accounts of these findings suggest that producers avoid using SOV for reversible events because they would be problematic for comprehension. For example, Meir et al. (2010) suggest that an SOV utterance like MAN WOMAN PUSH would be ambiguous to comprehenders. This claim is echoed by Napoli and Sutton-Spence (2014), who appeal to the same explanation to account for the same phenomenon in their survey of reports on word order in 41 different natural sign languages.

A somewhat different argument is offered by Gibson, Piantadosi, et al. (2013), who propose that including both nominal arguments on the same side of the verb is a risky choice when communicating via a noisy channel. Here the concern is less about ambiguity and more about the potential to recover meaning if part of the signal is not clearly transmitted, received, or retained in memory. For example, if “MAN” is lost to noise from the string MAN WOMAN PUSH, a comprehender may not be able to determine whether to assign WOMAN to the agent or patient role. However, if “MAN” is lost from the string MAN PUSH WOMAN, they propose that a comprehender would be able to correctly assign WOMAN to the patient role. (We note here that this proposal rests on an additional but unstated assumption: namely, that a comprehender will assume that agents are likely to appear pre-verbally. Otherwise, the string PUSH WOMAN would be equally difficult to parse.)

What both of these accounts share is the assumption that whatever the relevant pressures are, they apply similarly in production and comprehension, including the possibility that this is so because producers adopt strategies to accommodate (their estimates of) comprehenders’ preferences. We refer to this idea as the *concordance hypothesis*. It is worth noting that neither study provides direct evidence in support of this hypothesis. For example, Meir et al. (2010) do not provide evidence that comprehenders find SOV descriptions of reversible events to be ambiguous. Likewise, Gibson, Piantadosi, et al. (2013) do not provide evidence that SOV utterances are more vulnerable to information loss (or that SVO strings are less vulnerable to any such information loss). Thus, crucial predictions of the concordance hypothesis remain to be tested.

An alternative to the concordance hypothesis is that some of the factors that influence production are less relevant, or not relevant, in comprehension, and vice versa. We refer to this as the *independence hypothesis*. For example, Hall et al. (2013, 2014) suggest that producers avoid SOV for reasons that make no reference to what would or would not be difficult for a potential comprehender. Instead, this account is grounded in constraints on production alone, namely, that producers avoid being in the role of the patient at the time that they produce the action gesture – the “role-conflict” hypothesis. According to this account, SOV sequences work for non-reversible events because the participant only takes on one role: the agent. (For example, in a sequence such as MAN BOX PUSH, there is never a moment when the participant takes on the role of the box.) In contrast, for reversible events, participants generally take on

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