

Why do speakers use syntactically non-basic sentences?

Evidence from pupillometry and functional near-infrared spectroscopy

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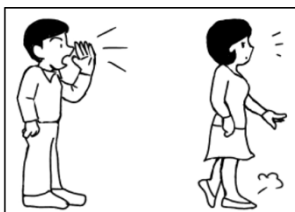
Natural languages have parametric variations in how they order subject (S), object (O), and verb (V) in a sentence: SVO in English and SOV in Japanese. In addition to syntactically basic word orders, many languages with flexible word orders allow non-basic word orders. In Japanese, SOV is syntactically basic, but O can move over S to form OSV. It has been well established in the psycholinguistic literature that basic word order has a processing advantage over other possible derived word orders in sentence comprehension. This raises the question of why speakers use non-basic word orders with syntactically more complex structures.

One possibility is that the non-basic sentences are used because they are more efficient for the speaker to produce. That is, speakers choose a structure that is easy to produce even though it may be difficult or unhelpful for listeners to understand. Ferreira and Yoshita (2003) showed that when native Japanese speakers were asked to recall a ditransitive sentence that originally had a new-given order, they produced the sentence in the given-new order by fronting a discourse-given argument over a discourse-new argument. Although these are offline production data, they suggest that non-basic word orders require less cognitive effort to speak when they allow speakers to place a discourse-given referent earlier than a discourse-new referent. We call this possibility the Speaker Economy Hypothesis.

Alternatively, it is possible that speakers produce them to help listeners understand sentences more efficiently, since listeners usually have no control over the input speed and inevitably have to recover a syntactic structure from a string of words at speech rate. In sentence comprehension, non-basic word orders have been found to be easier to process when the displaced constituent (e.g. O in Japanese) refers to discourse-given information compared to when it refers to discourse-new information. Thus, the use of non-basic word orders is motivated by listeners' efficient language processing. We refer to this possibility as the Listener Economy Hypothesis.

To test these hypotheses, we conducted a production experiment, in which participants (n = 20) described a picture while cognitive load was measured using functional near-infrared spectroscopy (fNIRS) and pupillometry. fNIRS is a non-invasive brain imaging technique that measures changes in the amount of regional oxyhaemoglobin in the brain, while pupillometry is an eye-tracking technique that measures the size of the pupil, which changes as a function of the cognitive load associated with sentence production. In the experiment, the participants were presented with a picture of a person and asked to describe it (e.g. 'There is a man/woman.'). They were then asked to describe a transitive event in SOV or OSV (e.g. 'The/a man called the/a woman.'). The first sentence 'There is a man/woman' made an S or O of the second target sentence discourse-given. Thus, we manipulated Word Order (SOV/OSV) and Context, creating four conditions: S-OGIVEN-V, SGIVEN-O-V, O-SGIVEN-V, and OGIVEN-S-V (20 trials for each condition). The Speaker Economy Hypothesis predicts that the production of OSV should be facilitated when O refers to discourse-given information whereas OSV should be difficult for speakers to produce regardless of the givenness of O according to the Listener Economy Hypothesis.

Pupillometry showed that a supportive context reduced the cost of producing OSV (i.e. OGIVEN-S-V). Consistent with this observation, the activation of the left inferior frontal gyrus decreased during the production of OSV when O referred to discourse-given information (vs. when it did not). An analysis of the speech onset latency showed that native Japanese speakers were faster to initiate their speech with OGIVEN-S-V than with O-SGIVEN-V, suggesting an advantage for the given-new order. We argue that these results are more consistent with the Speaker Economy Hypothesis.



Target sentences:

- | | | | |
|---------------------------------|----------------------|----------------------|-----------------------|
| (a) SOV: | dansei-ga
man-NOM | josei-o
woman-ACC | yobimasita.
called |
| 'The/a man called the/a woman.' | | | |
| (b) OSV: | josei-o
woman-ACC | dansei-ga
man-NOM | yobimasita.
called |