

The Role of Relatedness on Sentence Production

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In psychology, interference is observed in many domains. Specifically, semantic interference is observed in cyclical naming (Oppenheim et al., 2010, Howard et al., 2006) and picture word interference tasks (Rosinski, 1977). Likewise, sentences containing semantically similar entities take longer to produce (Smith & Wheeldon, 2004) and speakers make structure choices to alleviate interference (Gennari et al., 2012). In other tasks, semantic relatedness is facilitatory. In semantic priming tasks, related words lead to speeded responses (Neely, 1976). Likewise, speakers make fewer agreement errors when similar items are closer in a sentence (Gillespie & Pearlmutter, 2011). Semantic relatedness can lead to either interference or facilitation.

One possible reason for inconsistent findings is differences in the types of relatedness examined. Studies finding interference often investigate semantically *replaceable* entities: category members with a high feature overlap (a baseball player and basketball player). Studies finding facilitation often use entities that *co-occur* (a baseball player and a coach). *Co-occurring* entities may not interfere as they are not *replaceable* and would not be activated as competitors during lexical access (Levelt et al., 1991). *Co-occurring* entities may be easier to plan and produce in a sentence, whereas *replaceable* entities should be more difficult. We test predictions about co-occurring vs. replaceable entities in a picture-description sentence production task.

Speakers often make planning and production easier via implicit structure choices (Bock, 1982; MacDonald, 2013). We investigate the English dative alternation, which allows flexibility in speaking about transfer events. We investigate whether speakers choose sentence structures that allow them to separate semantically replaceable (interfering) entities (e.g., Prepositional Dative: The farmer is giving the bell to the fisherman vs. Double Object: The farmer is giving the fisherman the bell) or group co-occurring (facilitatory) entities (PD: The farmer is giving the corn to the ninja vs. DO: The farmer is giving the ninja the corn). This task allows us to investigate structure choices and speaking duration as a consequence of relatedness between entities.

Method: Stimuli were sets of images of two people transferring an item. We created 21 item quads (Table 1). All items in a quad had the same agent and included a related and unrelated recipient and item. Related people were chosen to be *replaceable*, defined by cosine similarity calculated using Spacy (Honnibal & Montani, 2017). Related items were chosen to co-occur using Wikipedia (Davies, 2015). Participants (N=23) saw one item per quad and items from each condition, and were given the verb to use on each trial but not the labels for entities in the pictures. To ensure name agreement, only items with 80% or higher name agreement on a norming task were used. The study was run using Psychopy3 (Pierce et al., 2019) on Zoom.

Results: We found no difference in the use of PD versus DO constructions across conditions (~70% PD/30% DO). However, effects of our manipulation are seen in speaking durations (Figures 1 & 2). When participants used the DO construction, they produced related people more quickly (Table 2). The results did not change when the Pointwise Mutual Information (PMI) values, a measure of co-occurrence that controls for word frequency (Bouma, 2009), between the agent/recipient and agent/item were added. In a model with only the two PMI values and cosine similarity between the agent and recipient, we saw an effect of cosine similarity (Table 3), suggesting that the relatedness between people, as defined by cosine similarity (not co-occurrence) accounted for the facilitation for related people. For the PD constructions, higher PMI values between the agent and item were associated with faster speaking times, but when producing the recipient (Table 4). Perhaps when easier-to-produce items precede recipients, speakers have extra planning time during the easier item phrase to plan the recipient.

Discussion: We saw no difference in PD or DO use across conditions. Effects of relatedness in timing measures were in the opposite direction as expected: relatedness between people appeared to speed, not slow, speaking times in DO constructions. In PD constructions, as predicted, related items did speed speaking times, but for the following (recipient) phrase. Potential reasons for these unexpected results and planned follow-up studies will be discussed.

Table 1: Experimental Design

Agent (Farmer)	Agent (Farmer)
Related Person (Fisherman)	Related Person (Fisherman)
Related Item (Corn)	Unrelated Item (Bell)
Agent (Farmer)	Agent (Farmer)
Unrelated Person (Ninja)	Unrelated Person (Ninja)
Related Item (Corn)	Unrelated Item (Bell)

Table 2: Mixed-effects model for DO Duration 1 (Recipient Duration)

DO Construction: Duration 1	β	SE	t	p
Intercept	0.927	0.076	12.169	< .001
Person Related	-0.169	0.082	-2.062	0.042
Item Related	0.004	0.081	0.047	0.963
Person Related x Item Related	-0.087	0.162	-0.538	0.592

Table 3: Mixed-effects model for DO Duration 1 with PMI & Cosine

DO Construction: Duration 1	β	SE	t	p
Intercept	0.937	0.075	12.512	< .001
PMI of Anchor and Person 2	0.076	0.067	1.145	0.255
PMI of Anchor and Item	0.039	0.04	-0.973	0.333
Cosine similarity of Anchor & Person2	-0.136	0.066	-2.061	0.042

Table 4: Mixed-effects model for PD Duration 2 (Recipient Duration)

PD Construction: Duration 2	β	SE	t	p
Intercept	1.127	0.063	17.989	< .001
PMI of Anchor and Person 2	0.022	0.059	0.376	0.709
PMI of Anchor and Item	-0.085	0.041	-2.054	0.041
Cosine similarity of Anchor & Person2	-0.046	0.055	-0.834	0.407

Figure 1: Boundaries and words included in each speaking duration for DO and PD sentences in an example item

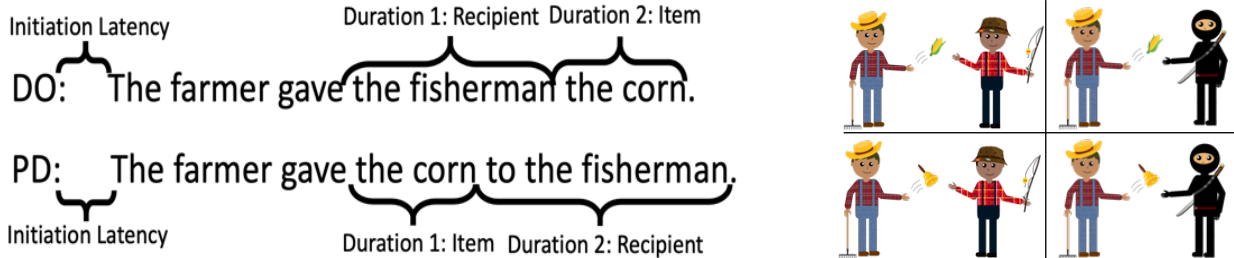
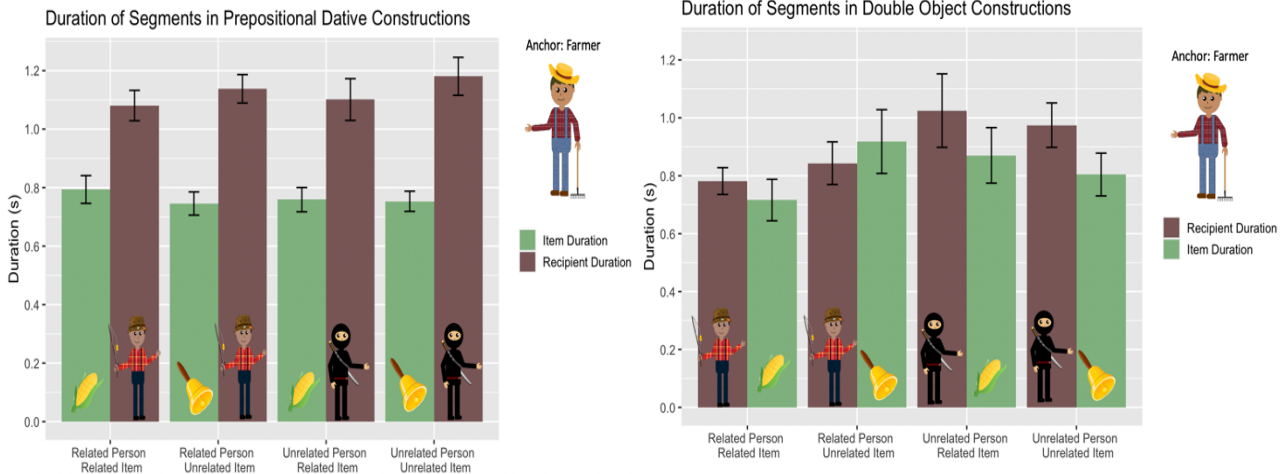


Figure 2: Speaking durations for DO and PD sentences



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