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Latency analysis for Rosa & Arnold (2017)
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A central question about language production is whether the predictability of meanings and structures affects speakers' choices, and why. Rosa and Arnold (2017) tested whether the predictability of thematic roles affects the speaker's choice between names and pronouns. In transfer verbs like *give* or *receive*, the goal character is considered more predictable than the source character, e.g. in *Sir Barnes received a painting of the two of them from Lady Mannerly*, Sir Barnes is the goal, and is expected to be mentioned in the following utterance.

Rosa & Arnold tested this question in experiment 1 using a spoken storytelling task. Speakers sat across the table from a live experimenter, who was playing the role of "Detective". The subject played the role of "photographer", and helped to describe pictures. On each trial, the subject saw two pictures, as in Figure 1. At the start of a trial, the two pictures appeared on screen. Then the detective described the first picture, e.g. *Lady Mannerly gave a picture of the two of them to Sir Barnes*, and the subject responded with a description of the second picture, e.g. *And he threw it into the closet*.



Figure 1. Sample stimuli in Rosa & Arnold, Exp. 1.

Rosa & Arnold reported that speakers used pronouns more often when referring to the goal than the source. They also reported that speakers were faster to begin speaking in the goal than the source conditions. Latency to speak was measured from the offset of the detective's sentence, until the onset of the fluent part of the response (including pre-speech disfluencies as a part of the latency period).

The latency analysis is important because it indexes the time taken to plan the response. The fact that goal responses were faster was an indication that they were easier to plan. This was consistent with evidence that goal responses are also judged as more related to the previous context.

However, this analysis did not take into account possible variation in the duration of the detective sentence. This is potentially relevant, because both panels appeared at the same time. Participants may have begun planning their response as soon as they saw the two panels, even during the period where they were listening to the detective sentence. If so, longer detective sentences would allow them more time to pre-plan. Pre-planning should reduce the amount of time needed to plan after the detective sentence ends, and thus could account for the latency effect. To test this possibility, I re-analyzed the latency data, taking the detective sentence length into consideration.

The detective sentence period was measured in Praat (Boersma & Weenik, 2015), defined as the period starting at the moment when the pictures appeared on screen, and ending at the offset of the detective's sentence. 443 trials were included in the analysis. This excluded one item where the latency was an outlier, and one item where the recording did not include the beep that signaled the start of the trial.

Table 1 shows the average length of the detective’s sentence across conditions (see Rosa & Arnold, 2017, for a description of experiment design). We analyzed the relationship between our experimental predictors and the detective sentence in a model with SAS proc mixed, using centered predictors. See Rosa & Arnold (2017) for our analytical approach. The model results are shown in Table 2, which reveals that the detective sentence length did vary by condition. Of particular interest is the fact that the goal conditions tended to be longer than source conditions, although this effect was modulated by an interaction with gender. Thus, detective sentence length could have contributed to our finding that the latency to respond was shorter for goals than sources.

Table 1. Average length of the detective’s sentence in each experimental condition.

Row Labels	subject		object	
	goal	source	goal	source
different	3498	3131	3460	3113
same	3552	3328	3373	3293

Table 2. Inferential statistics from a model of detective sentence length.

Effect	Effect (St. Error)	t	p
Subject vs. ObjPP continuation	83 (38)	2.17	0.03
Goal vs. Source continuation	152 (40)	3.81	0.0002
Order	-12 (1)	-8.73	<.0001
Same vs. Different gender	85 (38)	2.24	0.03
Subject * Goal	79 (76)	1.03	0.30
Subject * Gender	69 (76)	0.9	0.37
Goal * Gender	-254 (76)	-3.33	0.0009
Subject * Goal * Gender	74 (152)	0.48	0.63

* All random slopes by participant were estimated to be zero and removed from the model.

We therefore included the detective sentence length as a predictor of response latency. In this model, the log of the latency was our dependent variable. Our predictors were all centered,

and we included a maximal random effects structure. Random effects that were predicted to be zero by the model were excluded.

Table 3. Predictors of responses latency in Rosa & Arnold (2017), Experiment 1, controlling for detective sentence length.

Effect	Effect (St. Error)	t	p
Subject vs. ObjPP continuation	0.01 (0.02)	0.3	0.0002
Goal vs. Source continuation	-0.09 (0.02)	-4.32	<.0001
Order	0.001 (0.0007)	0.89	0.37
Same vs. Different gender	0.04 (0.02)	1.82	0.08
Subject * Goal	0 (0.04)	0.11	0.91
Subject * Gender	0.01 (0.04)	0.22	0.0009
Goal * Gender	0.06 (0.04)	1.63	0.1
Subject * Goal * Gender	0.14 (0.08)	1.82	0.07
Detective Sentence duration	-0.00004 (0.000024)	-1.7	0.09

* The random slope for detective sentence by subject was estimated to be zero and removed from the model.

The results of this analysis are shown in Table 3. Critically, we still observed the main effect of thematic role on response latency, even when controlling for detective sentence. The thematic role effect was modulated by an interaction with gender, and a marginal 3-way interaction with Subject and Gender. We therefore used estimates to probe the effect of thematic role across the subject and gender conditions. As shown in Table 4, the latency was significantly shorter in the goal than source conditions for all conditions except subject-continuation / same-gender. Figure 2 shows the average response latency by condition.

Table 4. Estimates of the Goal vs. Source contrast within the model of latency shown in Table 3.

Contrast	Effect (St. Error)	t	p
subj and same: Goal vs. Source	-0.02 (0.04)	-0.39	0.6963
subj and diff: Goal vs. Source	-0.15 (0.04)	-3.93	0.0001
objPP and same: Goal vs. Source	-0.09 (0.04)	-2.42	0.016
objPP and diff: Goal vs. Source	-0.09 (0.04)	-2.34	0.03

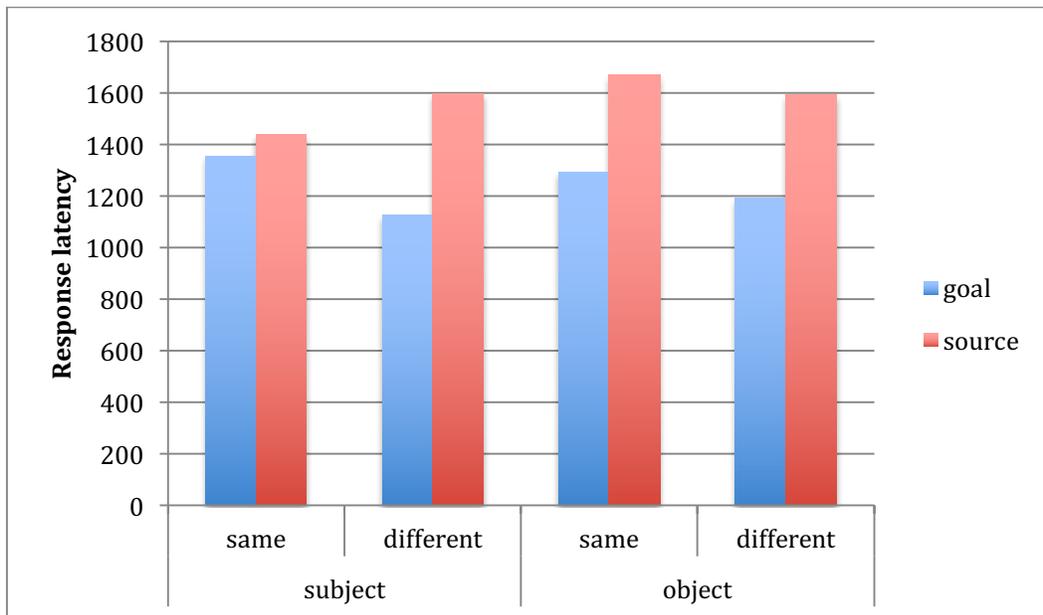


Figure 2. Average response latency (in milliseconds) across experimental conditions.

In sum, we report here a new analysis of response latency for data from Rosa & Arnold (2017), Experiment 1. We added the detective sentence length as a predictor in order to control for possible effects of pre-planning during the detective sentence. We found that this did not change the fundamental finding: goal continuations are generally faster than source continuations. Thus, sentences about goals appear to be easier to plan than sentences about sources.

References

Boersma, P. and Weenink, D. 2015. Praat: Doing phonetics by computer [Computer program]. Version 5.4.09, retrieved March 28 2016 from: <http://www.praat.org/>.

Rosa, E. and Arnold, J. E. 2017. Predictability affects production: Thematic roles can affect reference form selection. *Journal of Memory and Language*, 94, 43–60. DOI: <https://doi.org/10.1016/j.jml.2016.07.007>