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Prosodic Evidence for an Ellipsis-based Approach to *either…or…* Sentences

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1. Introduction

Puzzles posed by *either…or…* sentences have called for analyses involving two different syntactic operations: movement (e.g. Larson 1985; Johannessen 2005) and ellipsis (e.g. Schwarz 1999; Han & Romero 2004). Evidence for one type of analyses over the other has come from syntax itself as well as the syntax-semantics interface. This paper presents a novel source of evidence from prosody. As a proof of concept, I demonstrate that we can in fact look to prosodic/phonetic experiments for evidence for syntactic claims, adding to the small but growing literature on this topic (e.g. Clemens & Coon 2018; Clemens 2019). Not only does this project explore a new source of argumentation in syntax, but it also sheds light on the syntax-prosody mapping. Experimental evidence suggests that prosodic structure might correspond to syntactic structure more closely than previously thought, mapping not only maximal projections, but also non-maximal projections and different subclauses to different prosodic phrases.

2. Competing syntactic analyses of *either…or…* sentences

This paper studies the syntax of English sentences that have the form *either A or B*, where I call *A or B disjunction*, *A* and *B disjuncts*. An obvious hypothesis to entertain about the syntax of *either* is that it is always the sister of a disjunction phrase (DisjP) (e.g. Sag et al. 1985). If we consider the DisjP in (1) to be *rice or beans*, then *either* does seem to be its sister.

(1) Kim will eat **either** [$_{\text{DisjP}}$ rice or beans]. *Either*-seems-normal

This hypothesis is challenged by apparent counterexamples (observed by Larson 1985, Schwarz 1999, den Dikken 2006, among others). For example, if we still consider the DisjP to be *rice or beans* in (2a-b), *either* here appears structurally higher than the sister of the DisjP.[1] Therefore, I call sentences like (2a-b) either-*seems-high* sentences, to be contrasted with either-*seems-normal* sentences like (1).

(2) a. Kim will **either** eat rice or beans. *Either*-seems-high
b. Kim **either** will eat rice or beans.
c. **Either** Kim will eat rice or beans.

* I would like to thank Athulya Aravind, Edward Flemming, Danny Fox, Michael Kenstowicz, David Pesetsky, Roger Schwarzschild, and Michael Wagner for helpful comments and feedback. I am also grateful to the audiences at WCCFL 39, Goethe, McGill, Stanford, and UCSC. Thanks are also due to undergraduate research assistants Allie Amerman, Alyssa Solomon and Kitty Zeng for their help with collection and annotation of the data presented here.

[1] There is another type of *either…or…* sentences that also challenge the hypothesis that *either* is the sister of DisjP:

(i) a. Kim will **either** eat rice or she will eat beans. *Either*-seems-low
b. Kim **either** will eat rice or she will eat beans.

Assuming the DisjP in (i) coordinates two finite clauses (*Kim will eat rice or she will eat beans*), then *either* appears to be embedded inside the first disjunct, and thus structurally lower than the sister of DisjP. This paper focuses on *either*-seems-high sentences. See Wu (to appear) for an analysis of *either*-seems-low sentences.

There are two competing analyses of *either*-seems-high sentences in the literature. Both try to maintain the intuition that *either* is the sister of DisjP, but do so differently. First, the *movement-based account* argues that *either* originates as the sister of DisjP, and then moves to its surface position (Larson 1985; Johannessen 2005). It would analyze (2a-c) as in (3): *either* originates in the same position (sister of DisjP), but lands and surfaces in different positions.

(3) Movement-based analysis of (2a-c):
 a. Kim will either$_i$ eat t$_i$ [$_{\text{DisjP}}$ rice or beans].
 b. Kim either$_i$ will eat t$_i$ [$_{\text{DisjP}}$ rice or beans].
 c. Either$_i$ Kim will eat t$_i$ [$_{\text{DisjP}}$ rice or beans].

The other approach is what I call the *ellipsis-based account* (Schwarz 1999; Han & Romero 2004; Wu to appear), according to which *either*-seems-high is an illusion created by ellipsis. *Either* is always the sister of DisjP. When it seems high, ellipsis has applied in the noninitial disjuncts. It would analyze (2a-c) as involving different disjunction sizes (4). DisjP is always the sister of *either*, but it may appear smaller due to ellipsis:[2]

(4) Ellipsis-based analysis of (2a-c):
 a. Kim will either [$_{\text{DisjP}}$ eat rice or ~~eat~~ beans].
 b. Kim either [$_{\text{DisjP}}$ will eat rice or ~~will eat~~ beans].
 c. Either [$_{\text{DisjP}}$ Kim will eat rice or ~~Kim will eat~~ beans].

There has been some syntactic-semantic evidence for the ellipsis-based account over the movement-based account (Schwarz 1999; Han & Romero 2004; Wu to appear). I present evidence for the ellipsis-based account from a new source, prosody.

3. Prosodic predictions of the competing analyses

The two accounts make different prosodic predictions that can be tested experimentally. To illustrate this, I first present the minimal pair (5a-b) as a baseline. (5a) can be uttered in a context where it's presupposed that Chris saw someone else, and the assertion is that Chris also saw the couple Mary and Bill Sawyer. Despite having almost identical segments, (5a-b) have different prosodies. The most notable difference is in the prosodic boundary following *Mary*: it is larger in (5b) than in (5a).

(5) a. Chris saw Mary and Bill Sawyer too.
 b. Chris saw Mary and Bill saw her too.

This prosodic difference reflects their different syntactic structures: (5a) involves coordination of two DPs *Mary* and *Bill*, while (5b) coordinates two finite clauses:

(6) a. Chris saw [$_{\text{DP}}$ [Mary] and [Bill]] Sawyer too. *DP-coordination*
 b. [$_{\text{TP}}$ [Chris saw Mary] and [Bill saw her too]]. *Clausal-coordination*

Most theories on syntax-prosody mapping can account for this prosodic contrast between (5a & b). Let us first follow the common assumptions that prosodic elements are organized into constituents

[2] Technically, this ellipsis process involves two steps as are shown below: a) movement of the phrase that survives ellipsis (*beans*) out of the ellipsis site, plus b) phrasal ellipsis. I omit the movement step in all the illustrations of ellipsis in this paper for simplicity.

(i) Ellipsis-based analysis of (2a-c):
 a. Kim will either [$_{\text{DisjP}}$ eat rice or beans$_i$ ~~eat t$_i$~~].
 b. Kim either [$_{\text{DisjP}}$ will eat rice or beans$_i$ ~~will eat t$_i$~~].
 c. Either [$_{\text{DisjP}}$ Kim will eat rice or beans$_i$ ~~Kim will eat t$_i$~~].

(prosodic word (PWd), intermediate phrase (iP), intonational phrase (IP), etc.), and that prosodic phrases largely reflect syntactic phrases (e.g. Selkirk 1986, 2009, 2011; Wagner 2010; Elfner 2012, 2015). For example, Selkirk and Elfner's Match Theory maps a syntactic clause (TP or CP) onto an intonational phrase (IP), and a syntactic subclause (DP, VP, AP, etc.) onto an intermediate phrase (iP). They would thus map (5a-b) to the prosodic structures in (7a-b). *Mary* is followed by an iP boundary in (7a) because it is at the right edge of its own DP and no larger syntactic phrase, whereas *Mary* is followed by an IP boundary in (7b) because it is at the right edge of a clause:[3]

(7) a. They saw (Mary $_{iP}$) (and Bill Sawyer too.
    b. (They saw Mary $_{IP}$) (and Bill saw her too.

Under this simple assumption that prosodic phrases correspond to syntactic phrases in coordination, we can use prosodic evidence to adjudicate between the competing analyses of *either*-seems-high sentences. I begin with the prosodic predictions about one sentence, and then generalize to a paradigm of multiple sentences. First, consider (2c) again, and its movement-based analysis (3c) and ellipsis-based analysis (4c). Because these two analyses differ in the underlying disjunction size (DP-disjunction in (3c) and clausal coordination in (4c)), they correspond to different prosodic structures. For example, Match Theory would align *rice* at the end of an iP in the movement-based analysis because it is its own DP, but align *rice* at the end of an IP in the ellipsis-based analysis because it coincides with the end of a clause. Thus, the two syntactic analyses would predict different prosodic boundaries following *rice*.

	Syntactic analysis	Prosodic predictions
Movement-based account	(3c) Either$_i$ Kim will eat t$_i$ [$_{DisjP}$ rice or beans].	(Either$_i$ Kim will eat t$_i$ (rice $_{iP}$**)** or beans $_{IP}$).
Ellipsis-based account	(4c) Either [$_{DisjP}$ Kim will eat rice or she will eat beans].	(Either Kim will eat rice $_{IP}$**)** or she will eat beans.

Having presented the different prosodic predictions for a single sentence, let us examine a paradigm of multiple sentences that differ only in *either*'s position:

(8) a. Lillian will look for **either** Lauren or Bella.
    b. Lillian will **either** look for Lauren or Bella.
    c. Lillian **either** will look for Lauren or Bella.
    d. **Either** Lillian will look for Lauren or Bella.

The two syntactic analyses would assign different syntactic structures to these sentences, which in turn lead to different prosodic predictions:

	Syntactic analysis	Prosodic predictions
Movement-based account	(9) a. Lillian will look for **either** [$_{DP}$ Lauren] or [Bella]. b. Lillian will **either$_i$** look for t$_i$ [$_{DP}$ Lauren] or [Bella]. c. Lillian **either$_i$** will look for t$_i$ [$_{DP}$ Lauren] or [Bella]. d. **Either$_i$** Lillian will look for t$_i$ [$_{DP}$ Lauren] or [Bella].	(10) a. Lillian will look for **either** (Lauren**)** or Bella. b. Lillian will **either** look for (Lauren**)** or Bella. c. Lillian **either** will look for (Lauren**)** or Bella. d. **Either** Lillian will look for (Lauren**)** or Bella.

[3] To be precise, Match Theory was defined in the framework of Optimality Theory, and thus the syntax-prosody mapping I outlined is technically two constraints that may be dominated and overruled by some other constraint. I assume that in English coordination, these mapping constraints are not dominated by any constraint that would affect the prosodic boundaries.

	Syntactic analysis	Prosodic predictions
Ellipsis-based account	(11) a. Lillian will look for **either** [$_{DP}$ Lauren] or [Bella]. b. Lillian will **either** [$_{vP}$ look for Lauren] or [~~look for~~ Bella]. c. Lillian **either** [$_{T'}$ will look for Lauren] or [~~will look for~~ Bella]. d. **Either** [$_{TP}$ Lillian will look for Lauren] or [~~she will look for~~ Bella].	(12) a. Lillian will look for **either** (Lauren**)** or Bella. b. Lillian will **either** (look for Lauren**)** or ~~look for~~ Bella. c. Lillian **either** (will look for Lauren**)** or ~~will look for~~ Bella. d. **Either** (Lillian will look for Lauren**)** or ~~she will look for~~ Bella.

The movement-based account would analyze them as involving the same underlying disjunction, with the only difference being *either*'s landing position (9a-d). Because the disjunction is the same, and *Lauren* is at its right edge, *Lauren* should be followed by the same prosodic boundary regardless of *either*'s surface position (10a-d). It only matters to us that it is the same boundary, but does not matter exactly which boundary it is.

In contrast, the ellipsis-based account would posit different disjunctions, whose size is correlated with the position of *either* because *either* is always the sister of DisjP (11a-d). Because *Lauren* is at the right edge of the prosodic phrase mapped from the first disjunct, this would lead to different prosodic boundaries following *Lauren* (12a-d).

All the theories on syntax-prosody mapping would agree that at least the boundary after *Lauren* should be greater in (12d) than in (12a), but they would differ in what that boundary should be for (12a-c). Specifically, Selkirk's (1986) Edge Theory would assign the same strength to the boundary after *Lauren* in (12a-c) because Edge Theory maps all syntactic subclauses (DP, vP and $\overline{\text{T}}$ in our case) to the same prosodic level (iP). Selkirk's (2011) and Elfner's (2015) Match Theory would predict a two-way difference for (12a) vs. (12b-c) because Match Theory assumes that the mapping process only considers maximal projections XPs, and ignores non-maximal projections $\overline{\text{X}}$s ($\overline{\text{T}}$ in our case). Wagner (2010) would predict a three-way difference, where the boundary increases in strength progressively from (12a) to (12c) because according to him, the mapping process considers the level of syntactic embedding, and *Lauren* is less and less embedded from (11a) to (11d).

4. The experiment

4.1. Participants and materials

I conducted a production study with 13 native speakers of North American English (8 female, 5 male), who were all students at MIT. The speech materials for my experiment consisted of 7 target sentences, which came from two conditions: the Critical Condition had 4 items (8a-d that we saw), and the Control Condition had 3 items (13a-c). There were 146 filler items, which were items from other experiments.

***Either*'s position**	**Critical Condition**	**Control Condition**
A	(8a) Lillian will look for **either** Lauren or Bella.	
B	(8b) Lillian will **either** look for Lauren or Bella.	(13a) Lillian will **either** look for Lauren or she will look for Bella.
C	(8c) Lillian **either** will look for Lauren or Bella.	(13b) Lillian **either** will look for Lauren or she will look for Bella.
D	(8d) **Either** Lillian will look for Lauren or Bella.	(13c) **Either** Lillian will look for Lauren or she will look for Bella.

According to the ellipsis-based account, items in the Critical Condition vary in both the size of disjunction and the position of *either*. I thus included the Control Condition as a sanity check, to make sure that any effect I might find in the Critical Condition is not due to the surface position of *either*, but due to the disjunction size, since that is the prediction of the ellipsis-based account. In the Control

Condition, I again varied the position of *either*, just like in the Critical Condition, but I kept the disjunction size constant by always including a full clause in the second disjunct. Whereas we had 4 possible positions for *either* in the Critical Condition (positions A, B, C, D), only B, C, D were included in the Control Condition, because the corresponding A-sentence is ill-formed in English.

Some target sentences have ambiguity. According to some ellipsis-based account like Wu (to appear), the different meanings of (8a) are correlated with different disjunction sizes. To control for this, every target sentence was followed by a *but*-clause that disambiguates and elicits the desired meaning (e.g. the full item for (8a) is *Lillian will look for either Lauren or Bella, but she hasn't decided who*, which elicits the meaning that is associated with DP-coordination under the ellipsis-based account).

4.2. Data collection

Recording took place in a sound-attenuated booth at MIT. Participants were seated in front of a computer, which displayed one item at a time. The stimuli plus fillers were presented in pseudo-randomized order, and minimal pairs were not placed next to each other. Participants were given instructions about the task at the beginning of the experiment, which asked them to read each sentence quietly to themselves before proceeding to act it out naturally. If the participants were not satisfied with their rendition of an item (a common reason was that they stumbled over some words), they were allowed to say it again, in which case we only considered the rendition they were happy with, and discarded the previous renditions. Disfluent utterances were excluded, which were 12% of the total (N=48).

4.3. Data annotation

To measure the strength of the prosodic boundary immediately following *Lauren*, a research assistant and I transcribed the prosody using ToBI transcription conventions (Beckman and Ayers Elam 1997; Silverman et al. 1992), and took the break index of this boundary as the primary dependent measure. Following the ToBI tradition, the break index is an ordinal scale from 0-4, 4 being the strongest. The only way we differed from the ToBI tradition was in considering break index 2 to be smaller than 3 and larger than 1. Technically, break index is a mismatch of two cues, but I took both the presence of a tone and pre-boundary lengthening to be cues to a strong boundary, and the presence of only one cue to indicate a less strong boundary.

I supplemented this measure with three durational measures, which were annotated by three research assistants, and checked over by me. They are: (a) the duration of the last rime *en* of *Lauren*; (b) the duration of the period between the end of *Lauren* and the onset of the vowel in *or*, if this period exists (we labeled this period as a “filled pause”, which was often filled with glottalization); and (c) the duration in (b) plus the duration of *or*.

I chose these three durational measures because according to previous studies, they are all positively correlated with the boundaries between *Lauren* and *or*. Wightman et al. (1992) suggested that the duration of the last rime before a boundary reflects the strength of the boundary, lending support for our use of durational measure (a). Pierrehumbert (1995), Pierrehumbert & Talkin (1992) and Dilley et al. (1996) studied a series of glottalization effects, and showed that their duration reflect the boundaries before and after glottalization, suggesting that our durational measure (b) is an indicator of the strength of the boundaries after *Lauren* and before *or*. Assuming that the stronger the boundary before *or* is, the more prominent *or* is, then measure (c) largely reflects the strength of the boundary before *or*.

4.4. Data analysis

I fitted two ordinal logistic regressions, one for each condition, with the break index as the dependent variable. I also fitted six linear mixed effects models, three for each condition. Each model had one of the three durational measures as the dependent variable. All these regressions had item (helmert coded) as the fixed effect and by-subject random intercept.

4.5. Results

Transcriptions suggest that the break index following *Lauren* increases as we move from (8a) to (8d) in the Critical Condition (Figure 1), where (8d) has a larger break index than the average break index of (8a-c) ($p<0.01$), and (8c) has a larger break index than the average of (8a-d) ($p<0.01$). This is consistent with the predictions of the ellipsis-based account, but not the movement-based account.

In contrast, the break index following *Lauren* does not differ significantly between any sentence in the Control Condition (Figure 2). This suggests that the effect observed for the Critical Condition is not due to *either*'s surface position, but to disjunction size, which is expected by the ellipsis-based account.

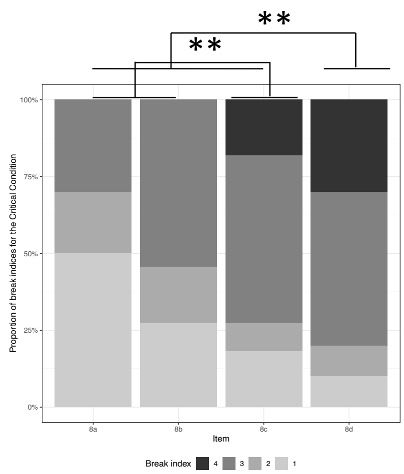

Figure 1*: Proportion of break indices for the Critical Condition.*

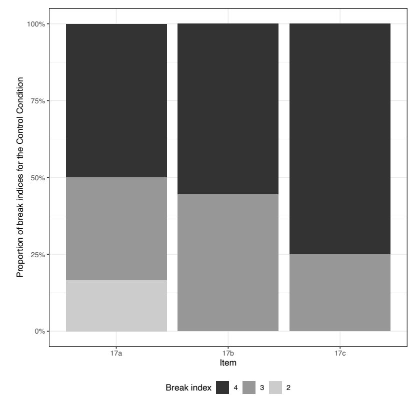

Figure 2: *Proportion of break indices for the Control Condition.*

Results of the three durational measures are presented in the Appendix.

5. Discussion

The results have two-fold consequences. First, they provide prosodic evidence for one syntactic analysis of *either*-sees-high sentences over the other. Transcriptions suggest that the prosodic boundary following *Lauren* increases in strength as we move from (8a) to (8d) in the Critical Condition, and the durational evidence points to the same direction. These results support the ellipsis-based account of *either*-seems-high sentences, which argues for an increasing disjunction size from (8a) to (8d), and thus prosodic boundaries that also increase in strength. The results challenge the movement-based account, which argues for the same disjunction for (8a-d), and thus the same prosodic boundary for them.

Second, these results inform us about the syntax-prosody mapping, suggesting that prosodic structure corresponds to syntactic structure more closely than some theories claimed. Based on the prosodic results, suppose the ellipsis-based account is correct, then *Lauren* is aligned to the right edge of a DP in (8a), a vP in (8b), a $\overline{\mathrm{T}}$ in (8c), and a TP in (8d).

Following the results based on break indices and some durational measures, a $\overline{\mathrm{T}}$ (8c) may be mapped to a larger prosodic phrase than a vP or a DP (8a-b). This would challenge theories on syntax-prosody mapping that claim that the mapping process only considers XPs, but ignores $\overline{\mathrm{X}}$s (e.g. Selkirk's (1986) edge-based theory and Match Theory by Selkirk (2011) and Elfner (2015)).

If the results based on break indices are correct that a DP (8a), a vP (8b), a $\overline{\mathrm{T}}$ (8c) and a TP (8d) are all mapped to prosodic phrases with different strengths, this will challenge mapping theories that map all subclauses (e.g. vP and DP) to the same prosodic level (e.g. Selkirk's (1986) edge-based theory).

These results are compatible with mapping theories that refer not to the syntactic label of phrases, but to the level of embedding (e.g. Wagner 2010). Because *Lauren* is less and less embedded from (8a) to (8d), the prosodic boundary increases in strength.

6. Conclusion

I have presented evidence from a prosodic / phonetic experiment that is consistent with the syntactic account of *either…or…* sentences that involves ellipsis, but not with the account that involves movement, thus arguing for the ellipsis-based account over the movement-based one. This project demonstrates that with minimal assumptions about the syntax-prosody mapping, we can in fact use prosodic evidence in syntactic argumentation. It also provides insights about the syntax-prosody mapping, suggesting that prosody might track syntax closely than some previously claimed, possibly mapping non-maximal projections to prosodic phrases, and distinguishing between different subclauses.

Appendix. Results of durational measures

Before presenting the results of the durational measures, I should note that these are only tendencies. The data are underpowered because there is a small number of observations (N=48) in an otherwise complex model (3-4 levels for the fixed effect). Still, they are in the direction consistent with the results of the break indices. I plan to replicate this experiment with a larger sample of data once the pandemic is over, and people are allowed back into phonetic labs.

The duration of the last rime *en* of *Lauren* seems to increase as we move from (8a) to (8d) in the Critical Condition (Figure 3), where the duration of *en* is 19.6ms longer in (8c) than the average of (8a-b) ($p<0.05$). In contrast, there is no significant difference in the duration of *en* between utterances in the Control Condition (Figure 4).

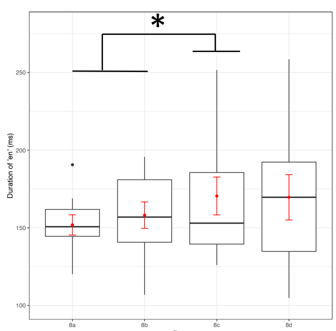

Figure 3: *Duration of* en *for the Critical Condition.*

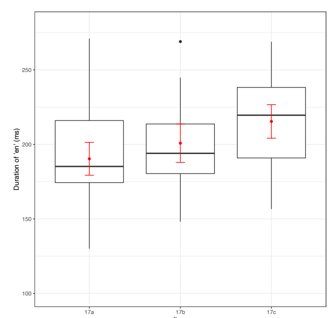

Figure 4: *Duration of* en *for the Control Condition.*

The duration of the filled pause between *Lauren* and *or* seems to have an increasing tendency as we move from (8a) to (8d) in the Critical Condition (Figure 5), though no comparison was statistically significant. We also found no significant difference in the Control Condition (Figure 6).

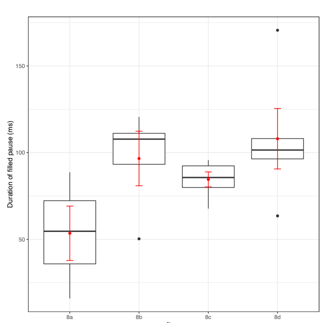

Figure 5: *Duration of filled pause for the Critical Condition.*

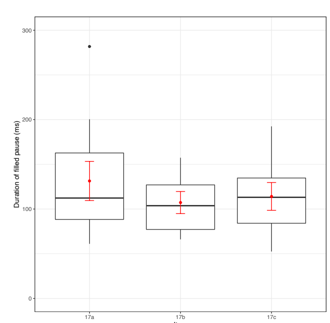

Figure 6: *Duration of filled pause for the Control Condition.*

Finally, the duration of the filled pause plus *or* seems to increase as we move from (8a) to (8d) in the Critical Condition (Figure 7), where that duration in (8d) is 53.5ms longer than the average of (8a-c) ($p<0.05$). In contrast, there is no significant difference for the Control Condition (Figure 8).

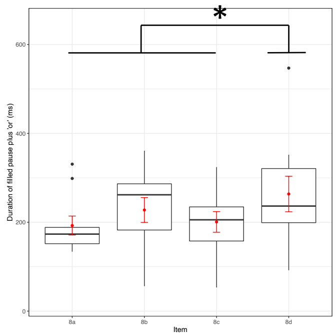

Figure 7: *Duration of filled pause plus* or *for the Critical Condition.*

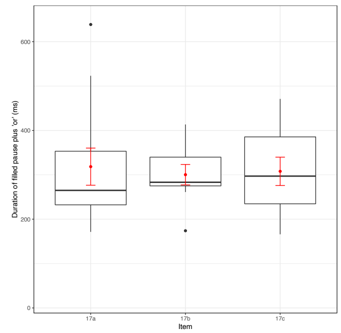

Figure 8: *Duration of filled pause plus* or *for the Control Condition.*

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