(A)SYMMETRIES IN TAGALOG RELATIVE CLAUSE PROCESSING*

Jed Sam Pizarro-Guevara
University of Massachusetts, Amherst
jpguevara@umass.edu

Matthew Wagers
University of California, Santa Cruz
mwagers@ucsc.edu

We report the results of a picture-selection experiment in Tagalog that examined (i) whether the object relative clauses (ORCs) were more difficult to process than subject relative clauses (SRCs) and (ii) if so, whether the relative order of the head noun and the RC modulated this asymmetry. We found that ORCs were more difficult to process than SRCs when the RC was head-initial. This asymmetry was neutralized, however, when the RC was head-final. Even though the participants' selection ultimately showed neutralization, we found evidence for an asymmetry in how quickly they offered correct responses.

1. Introduction

This paper investigates how RELATIVE CLAUSES (RCs) are processed in Tagalog. As we will see below, one of the core findings in RC processing research is that comprehenders prefer RELATIVE CLAUSES WITH SUBJECT-GAPS (SRCs), as in 1a, over RELATIVE CLAUSES WITH OBJECT-GAPS (ORCs), as in 1b. Throughout, we refer to this preference as the asymmetry.

(1) *Adapted from Kwon et al. (2010)*
   a. The reporter that __ attacked the senator disliked the editor *SRC*
   b. The reporter that the senator attacked __ disliked the editor *ORC*

We ask whether (i) the asymmetry is observed in Tagalog and (ii) if it is, whether other factors—like the relative order of the head noun and the RC, for instance—can modulate it. Previous studies in Tagalog indicate that ORCs are more difficult to process than SRCs (Pizarro-Guevara 2014; Bondoc et al. 2018; Tanaka et al. 2019). These studies, however, have only investigated head-initial RCs. Whether the same holds true for head-final RCs remains an empirical question. In Chamorro, a related language, Wagers et al. (2018) found a robust asymmetry in head-initial RCs but a modest reversal in head-final RCs. Their results provide evidence for word order modulating the asymmetry. Here, we also leveraged the word order flexibility that Tagalog RCs offer to conduct a language-internal comparison of how RCs in both word orders are processed and to evaluate the empirical coverage of the various proposals in the literature to account for what seems to be a robust asymmetry cross-linguistically. In short, we found that ORCs were more difficult to process in head-initial RCs, replicating previous studies on Tagalog RCs. We found that the asymmetry was neutralized in head-final RCs. However, we found evidence for the asymmetry persisting in how quickly participants offered correct responses. Empirically, our findings replicate

*We thank Melvin Santiago for the illustrations and Mantha Sadural for being the voice actor in our experiments. We are indebted to Divine Endriga, Henrison Hsieh, Kristina Gallego, Rowena Garcia, and Nozomi Tanaka for their help with the facts about the language; to the Department of Linguistics at the University of the Philippines – Diliman for their help with participant recruitment; and to Sandy Chung, Amanda Rysling, and the audience at AFLA 26 and at the 33rd Annual CUNY Human Sentence Processing Conference for their comments and questions. All mistakes are our own. This work was supported by the National Science Foundation under NSF BCS 0753240 to UC Santa Cruz.

and extend previous findings. Theoretically, our findings cannot be accounted for by any single class of proposal if we continue to treat these proposals as inert. If we accept that they are different pieces of information that we as comprehenders must coordinate in real-time, then the question that should be asked is when they contribute to the asymmetry.

The remainder of the paper is organized as follows. Section 2 provides the two research strands that emerge in RC-processing. We first review the classes of explanations proposed in the literature to account for the asymmetry. We then review some of the factors that have been reported to attenuate the asymmetry. Section 3 provides the relevant features of Tagalog morphosyntax. Section 4 presents the picture-selection experiment. Finally, section 5 concludes by discussing our findings and contextualizing what the empirical landscape of RC processing in Tagalog can tell us about the classes of explanations in the literature to account for what seems to be a robust asymmetry cross-linguistically.

2. Background: Processing of relative clauses

Two related research strands have emerged in RC-processing. One strand focuses on when this asymmetry holds and proposes various ways to account for it. The other strand focuses on when this asymmetry breaks down and views this attenuation as a window into how RCs are processed.

As mentioned above, one of the core findings in RC processing research is that comprehenders prefer SRCs over ORCs. This asymmetry comes in two flavors. First, in languages with unambiguous RCs, ORCs have been found to be more difficult to process than SRCs. In other words, sentences like 1b are found to be harder to process compared to sentences like 1a. What "harder" actually means varies from study to study, largely depending on the methodology that researchers have used. This could mean lower percent correct in a repetition task (Diessel and Tomasello 2005), a picture-selection task (Tanaka et al. 2019), or a memory-load experiment (Gordon et al. 2002); slower reading times in self-paced reading (Gibson et al. 2005); or in eye-tracking while reading, higher incidence of regressive eye movements from the subject (Staub 2010) or longer fixation durations during regressive re-reading (Gordon et al. 2006). Second, in languages with globally ambiguous RCs, comprehenders offer fewer ORC-interpretations relative to SRC-interpretations. Here, we focus on the first flavor of the asymmetry.

This asymmetry seems to hold quite robustly across typologically different languages using a variety of behavioral and neural measures, in both child- and adult-langauges: Avar (Polinsky et al. 2012); Chamorro (Wagers et al. 2018); Chinese (Vasishth et al. 2013; Wu et al. 2012); Dutch (Frazier 1987; Mak et al. 2002, 2006); Ch'ol and Q'anjob'al (Clemens et al. 2015); English (Gibson et al. 2005; Grodner and Gibson 2005; King and Just 1991; King and Kutas 1995; Traxler et al. 2002, 2005); French (Cohen and Mehler 1996); German (Bader and Meng 1999); Georgian (Foley and Wagers 2017); Hebrew (Arnon 2010); Italian (Arosio et al. 2011); Japanese (Ueno and Garnsey 2008); Korean (Kwon et al. 2010); Russian (Levy et al. 2013); Spanish (Betancort et al. 2009); Tagalog (Pizarro-Guevara 2014; Bondoc et al. 2018; Tanaka et al. 2019).

2.1. Accounting for the asymmetry

There are a number of proposals in the literature that have been argued to account for this well-known asymmetry. Broadly speaking, these proposals can be grouped into two classes, depending on what aspect of the dependency they emphasize. Some proposals emphasize the role of intervening linguistic material. Others emphasize the role of linguistic experience.

2.1.1. The role of intervening material

There are two flavors of intervention-based proposals: (i) those that emphasize structural locality; and (ii) those that emphasize the role of working memory, whose constructs are operationalized in terms of linear locality. While these proposals vary in terms of how they define what is considered intervening linguistic material, the basic intuition behind how processing difficulty is quantified remains the same. These proposals relate processing difficulty to the number of intervening elements, such that the greater the number of interveners, the more difficult the dependency is.

Structural locality. Proposals that emphasize structural locality define intervention in terms of the number of syntactic projections intervening between the head noun and the gap (Hawkins 1999; O'Grady et al. 2003). Under this view, the subject-object asymmetry obtains because of how we combine the verb and its co-arguments. By hypothesis, subjects are generated in a structurally higher position than objects. Different proposals vary in their assumptions about how articulated the clausal spine is. However, in a sense, how articulated it is has very little effect on how structural locality is quantified. The exact number of intervening projections will vary from proposal to proposal, but the overall pattern remains consistent: the number of intervening projections that ORCs have will always be greater than that of SRCs.

Linear locality. These proposals define intervention in terms of the linear distance between the head noun and the gap (Gordon et al. 2001; Hsiao and Gibson 2003; Grodner and Gibson 2005; Lewis and Vasishth 2005; Van Dyke and McElree 2006; Carreiras et al. 2010). These proposals frame the effects of linear distance as a function of working memory. The main intuition is that increasing the linear distance imposes a greater burden on our working memory, which then leads to greater processing difficulty. Under this view, the asymmetry obtains because there are more elements that linearly intervene between the head noun and the gap in ORCs than in SRCs.

There are various ways researchers have framed how linear distance affects working memory capacity and thus, how the asymmetry obtains. Here, we focus on how linear distance affects the retrieval process indirectly. See Gibson (1998) for a discussion on how it can be framed in terms of storage or integration costs. As already mentioned, linear distance can also affect the retrieval process indirectly. Language comprehension requires accessing representations of items in memory that may not be what is currently being processed. This is especially true in dependencies like RCs. In a cue-based architecture of memory, the retrieval process is susceptible to SIMILARITY-BASED INTERFERENCE (Gordon et al. 2001; Van Dyke and Lewis 2003; Lewis and Vasishth 2005). Under this view, processing difficulty is modulated by how similar the items are in memory, and not by linear distance per se. Increasing the linear distance between the head noun and the gap can increase processing difficulty because it could add more items in memory that could compete with the head noun during retrieval. Framed this way, ORCs are more difficult to process than SRCs because in ORCs, the subject competes with the head noun during the retrieval process because they have overlapping features (e.g., they are both [+ANIMATE] NPs). One key prediction of similarity-based interference is that this asymmetry will be reduced or leveled if the items in memory become more dissimilar. There is evidence suggesting that the asymmetry is indeed reduced when the intervening element is dissimilar. For example, Gordon et al. (2004) compared SRCs and ORCs by varying the referential type of the co-argument, as in 2. They found when the intervening co-argument in ORCs is the proper name *Bob*, the pronoun *you*, or the quantified expression *everyone*, the asymmetry is reduced in both reading times and accuracy.

(2) *Adapted from Gordon and Lowder (2012)*
   a. The senator that bothered (the reporter/Bob/you/everyone) caused . . . *SRC*
   b. The senator that (the reporter/Bob/you/everyone) bothered caused . . . *ORC*

2.1.2. The role of linguistic experience

The main premise of these proposals is that the way in which comprehenders parse sentences is shaped by their prior exposure to their language. One class emphasizes the role of how frequent RCs are in the language, which influences how comprehenders generate expectations in terms of what are likely continuations. Another class emphasizes how similar RCs are to main clauses.

Frequency. Frequency-based proposals argue that the ease of processing RCs is correlated with the relative abundance of the type of RCs in the language (Mitchell et al. 1995; Brysbaert and Mitchell 1996; Reali and Christiansen 2007). Under this view, ORCs are more difficult to process than SRCs because ORCs are not as frequent in the language. This is borne out in English. Roland et al. (2007) analyzed 5 English corpora—the British National Corpus (BNC), BNC-Spoken, Brown, Switchboard, and Wall Street Journal Treebank—and found that ORCs were indeed less frequent compared to SRCs across 5 corpora.

Frequency-linked difficulties have been formalized in the literature in terms of surprisal (Levy 2006). As comprehenders, we generate expectations in terms of what continuations are possible. Framed this way, processing difficulty is inversely related to the degree to which the input is consistent with our expectations. More concretely, after encountering *that* in 3, an SRC-continuation, as in 3a, is much more likely given that SRCs are more frequent in the language. Thus, SRCs are preferentially expected by comprehenders. An ORC-continuation, as in 3b, is more surprising given that ORCs are not as frequent, and thus, is more difficult to process.

(3) The reporter that ...
   a. attacked the senator disliked the editor *SRC-continuation = low surprisal*
   b. the senator attacked disliked the editor *ORC-continuation = high surprisal*

Main clause similarity. These classes of proposals relate processing difficulty as a function of how similar the order of the RC is to the order of the main clause (Bever 1970; Diessel and Tomasello 2005). The more similar they are, the easier it is to process. In English, subjects precede objects in main clauses (i.e., S > O, where '>' means precede). The order of elements closely resembles this order in an SRC (i.e., Head_S > O) but not in an ORC (i.e., Head_O > S).

2.2. Attenuating the asymmetry

A related strand of research examines when the asymmetry breaks down. We have already seen one context where the asymmetry breaks down in English: when the head noun and the co-argument in the RC are of different referential types (Gordon et al. 2004; Gordon and Lowder 2012). This has also been replicated in Russian (Price and Witzel 2017). Another context where the asymmetry breaks down is when the head noun is inanimate. For example, in Dutch (Mak et al. 2002, 2006), Chinese (Wu et al. 2012), and English (Traxler et al. 2005; Lowder and Gordon 2014), an ORC with an inanimate head noun was not any more difficult than an SRC.

Another context where the asymmetry breaks down is when we compare head-initial and head-final RCs. In languages with head-initial RCs, the asymmetry is robust. However, in languages with head-final RCs, some (e.g., Japanese) show a clear asymmetry in the expected direction (Ueno and Garnsey 2008). Some (e.g., Basque), in the other direction (Carreiras et al. 2010). Others (e.g., Chinese) found mixed results (Hsiao and Gibson 2003; Gibson and Wu 2013, *c.f.* Jäger et al. 2015). Thus, when we compare languages that have head-initial RCs and languages that have head-final RCs, there is a tenuous generalization that can be made: The relative order of the head noun and the RC seems to modulate the asymmetry.

It is important to keep in mind, however, that this generalization was formulated by comparing *different* languages. A skeptic might argue that the purported effect of word order on the modulation of the asymmetry is confounded by the fact that we are comparing different languages. In other words, it is not easy to divorce the independent contribution of word order on the modulation of the asymmetry from language-specific properties. A stronger case could be made for word order effects if language is held constant. What is needed then is a language where it is possible to have both head-initial and head-final RCs—a typologically rare property for a language to have (Dryer 2013). Any observed differences can then be attributed to "purer" word order effects.

More recently, Wagers et al. (2018) compared how SRCs and ORCs are processed in Chamorro, an Austronesian language of the Marianas. One crucial feature of Chamorro grammar is that it allows for both head-initial and head-final RCs, as in 4.

(4) *Adapted from Wagers et al. (2018)*

a. Kao siña un li'i' atyu na tåotao [i matåta'chung]? *Head-initial*
Q can AGR see that LNK person COMP AGR.sit.PROG
'Can you see the man who is sitting down?'

b. Kao siña un li'i' atyu i [matåta'chung] na tåotao? *Head-final*
Q can AGR see that the AGR.sit.PROG LNK person
'Can you see the man who is sitting down?'

This feature allowed Wagers et al. to investigate how RCs were processed in both word orders *language internally*. They found the following. First, in head-initial RCs, Chamorro comprehenders preferred SRCs over ORCs. This echoes the well-known asymmetry. Second, in head-final RCs, Chamorro comprehenders displayed a modest preference for ORCs over SRCs. This echoes the effect of word order on the modulation of the asymmetry. Finally, even though comprehenders ultimately preferred ORCs in head-final configurations, they were still faster at providing the correct interpretation when it was an SRC. What we can learn from this language internal comparison is that even when word order effects modulate the asymmetry, it nevertheless leaves a lingering "footprint" in our processing behavior.

3. Relevant features of Tagalog morphosyntax

First, Tagalog is a head-initial language in which the predicate comes first in the clause. The order of post-verbal elements is relatively flexible. That is, they can scramble and still retain the grammaticality and the basic meaning of the sentence (Schachter and Otanes 1983). Even though the order after the verb is relatively free, some word orders are more natural than others. There are three competing pressures that can affect it:

(5) *Adapted from Kroeger (1993)*
   a. SUBJECT-FIRST: the subject (=agent) tends to precede all other arguments
   b. NOMINATIVE-LAST: the *ang*-marked argument tends to follow other arguments
   c. HEAVY NP SHIFT: "heavier" arguments tend to follow "lighter" arguments

Consider the examples in 6. When the verb has PATIENT VOICE (PV), VSO, as in 6a, is considered to be more natural than VOS, as in 6b. VSO is preferred because it satisfies *both* of subject-first and nominative-last pressures, holding heaviness constant.

(6) *The most natural word order for verbs with PV is VSO*
   a. Iniinom ng babae ang alak *VOS*
      drink.PV GEN woman NOM wine
      'The woman is drinking the wine.'
   b. ?Iniinom ang alak ng babae *VOS*
      drink.PV NOM wine GEN woman
      'The woman is drinking the wine.'

Consider the examples in 7. When the verb has AGENT VOICE (AV), VSO and VOS order are considered to be natural. No word order is optimal since both word orders satisfy one pressure at the expense of another. With VSO, subject-first is satisfied at the expense of nominative-last. With VOS, it is the reverse: nominative-last is satisfied at the expense of subject-first.

(7) *The most natural word order for verbs with AV is either VSO or VOS*
   a. Umiinom ang babae ng alak *VSO*
      drink.AV NOM woman GEN wine
      'The woman is drinking wine.'
   b. Umiinom ng alak ang babae *VOS*
      drink.AV GEN wine NOM woman
      'The woman is drinking wine.'

There is experimental evidence suggesting that comprehenders are sensitive to these pressures in real-time (Bondoc and Schafer 2019). This discussion about the interaction between voice and word order is relevant for accounts that appeal to the similarity between the word order of a language's main clause and the order of the elements involving a RC in that language (Bever 1970; Diessel and Tomasello 2005). This may also be relevant for accounts that appeal to linear locality, assuming that how we calculate linear distance is based on the surface order of the arguments.

Finally, Tagalog allows the head noun to surface in a variety of positions with respect to an RC modifier (Aldridge 2017; Law 2016). We leveraged this feature of the language to compare how both head-initial and head-final RCs were processed language internally. Other crucial facts about Tagalog RCs for present purposes are the findings of the corpus analysis by Nagaya (2019): (i) head-initial RCs are more frequent than head-final RCs; and (ii) ORCs are more frequent than SRCs. These pieces of information are directly relevant to accounts that appeal to frequency to account for the asymmetry.

4. The present study

We conducted three experiments at the University of the Philippines – Diliman in the summer of 2019. These were run simultaneously in one session. For reasons of space, we will only report one in this paper. In this paper, we compared how unambiguous SRCs and ORCs were processed in both head-initial and head-final configurations. The 16 experimental items involved full NPs as co-arguments. We chose to report this experiment because its design maximizes the comparability of our findings to other studies since most studies investigating how SRCs and ORCs are processed also use co-arguments that are full NPs. Perhaps more importantly, this maximizes the comparability of our findings and those of Wagers et al. (2018).

The other experiments compared how unambiguous RCs were processed in both word orders when the co-argument was a pronoun, and how ambiguous RCs were processed in both word orders. Across the 3 experiments, the results were qualitatively similar: even when other factors (e.g., word order, pronominality of the co-argument) modulate the asymmetry, we still find a lingering asymmetry in their RTs—echoing the findings of Wagers et al. (2018) in Chamorro.

4.1. Participants

We recruited 65 speakers from UP – Diliman. They ranged from 18 to 59 years of age (M = 25, SD = 8), and all lived in and around Metro Manila at the time of testing. They received a gift certificate valued at 300 Philippine Pesos for participating.

4.2. Materials

The experiment employed a 2×2 design, crossing whether the RC was head-initial or head-final (ORDER: HI, HF) and whether the RC was an SRC or an ORC (PARSE: SRC, ORC). We created 16 items involving reversible predicates. Each item was distributed evenly across four lists via Latin Square design. The items of this experiment were combined together in one session and randomized with the 72 items from the other experiments. Provided in Table 4.2 is a sample item.

4.3. Procedure

The experiment was a picture-matching task with eye-tracking. It was deployed in OpenSesame (Mathôt et al. 2012), using a Surface Pro tablet. A typical trial is provided in Figure 1.

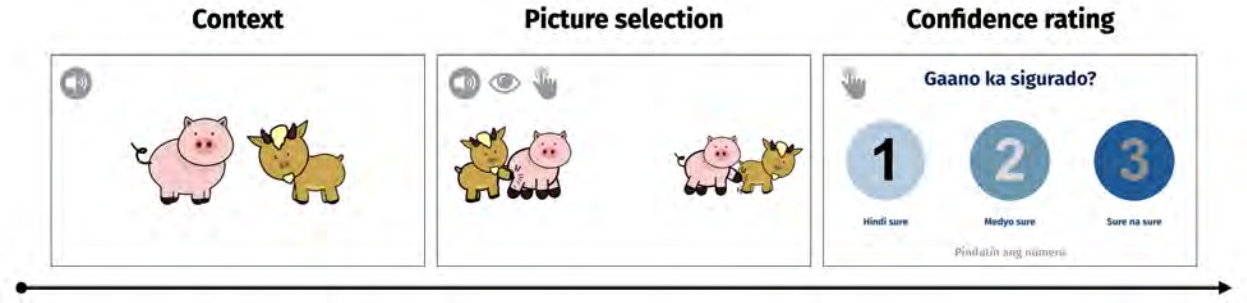

Figure 1: A schematization of typical trial. There are three main events per trial: (i) Context presentation; (ii) Picture selection task with eye-tracking; and (iii) Confidence rating.

Table 1: Sample experimental item, manipulating ORDER (HI, HF), and PARSE (SRC, ORC). The head noun is bolded and the RCs are demarcated by "[]."

ORDER	PARSE					
		May	isang	baboy	at	kambing
		EXIST	one.LNK	pig	and	goat
		'There is a pig and a goat.'				
		Minsan	gusto	nilang	manipa	
		sometimes	want	3PL.GEN.LNK	maN.kick	
		'Sometimes they like to kick.'				
		Minsan	naman	gusto	nilang	magpasipa
		sometimes	also	want	3PL.GEN.LNK	magpa.kick
		'Sometimes they also likes to be kicked.'				
		Piliin	ang	larawan	ng ...	
		choose.PV	NOM	picture	GEN	
		'Choose the picture of ...'				
HI	SRC	**baboy**	na	[sumisipa	ng	kambing]
		pig	LNK	kick.AV	GEN	goat
		'... the pig that is kicking the goat.'				
HI	ORC	**baboy**	na	[sinisipa	ng	kambing]
		pig	LNK	kick.PV	GEN	goat
		'... the pig that the goat is kicking.'				
HF	SRC	[sumisipa	ng	kambing]	na	**baboy**
		kick.AV	GEN	goat	LNK	pig
		'... the pig that is kicking the goat.'				
HF	ORC	[sinisipa	ng	kambing]	na	**baboy**
		kick.PV	GEN	goat	LNK	pig
		'... the pig that the goat is kicking.'				

Participants saw a context screen that contained two animals. They then heard a recording of a context introducing the characters associated with a particular trial. This context was also a way to get the participants acquainted with the verb used in this trial. Crucially, the way in which verbs were inflected in the context screen never matched how participants heard them embedded inside an RC. After the offset of the context recording, participants saw another screen that contained two pictures in which the two animals are performing the same action to each other. They then heard a recording containing the experimental item. They were to choose the picture that best represented what they had just heard. They had three seconds to choose a picture after the audio offset; otherwise, it would time out. Using a Tobii Pro Nano eye-tracker, we tracked where on the screen (i.e., which picture) they were looking at from the onset of the recording containing the experimental item until they chose a picture. Finally, after they had chosen a picture (or not if they had timed out), participants had to rate how confident they were with their response. They were explicitly instructed that if they timed out, they had to press 1 *hindi sure* "not sure."

4.4. Data analysis

We used two measures to compare how SRCs and ORCs were processed. The first measure was the participants' choice data. The second measure was how quickly participants offered a correct interpretation, their RT data. There is a third measure, the participants' gaze data (i.e., where they were looking at as the recording of the RC was playing), that we are still analyzing.

We excluded observations where participants had timed out (i.e., 3 seconds after audio offset of the picture-selection event) and where they clicked outside the regions of interest. These criteria led to 3.8% of the observations being excluded.

To get a more nuanced picture of their choice, we took into account their response (i.e., whether they chose the correct or incorrect response for unambiguous RCs, and whether they chose an SRC-interpretation or an ORC-interpretation for ambiguous RCs) and their confidence rating. Thus, we derived an ordinal scale with 6 values: "Incorrect, really confident", "Incorrect, somewhat confident", "Incorrect, not confident", "Correct, not confident", "Correct, somewhat confident", and "Correct, confident". We then estimated cumulative link mixed models using the *Ordinal* package (Christensen 2018) in R (R Core Team 2018). We included the maximal random effects structure justified by the design that allowed the models to converge (Barr et al. 2011; Barr 2013).

For the RTs, we estimated linear mixed effects models using *lme4* (Bates et al. 2015) in R. We then included the maximal random effects structure that allowed the models to converge.

4.5. Predictions

Structural locality. Recall that the structural locality view relates processing difficulty to the number of syntactic projections intervening between the head noun and the gap. The greater the number, the more difficult it is to process. It is perhaps uncontroversial to assume that the mechanism by which we combine the verb and its co-arguments is the same in English and Tagalog. That is, subjects are generated in a structurally higher position than objects. Let's assume that the algorithm for counting intervening syntactic projections operates at the level where co-arguments are base-generated. This predicts an asymmetry, where SRCs will be processed easier than ORCs, because the number of intervening projections that ORCs have will always be greater than that of SRCs—no matter how articulated the assumed clausal spine is.

Linear locality. Recall that the linear locality view relates processing difficulty to the number of elements linearly intervening between the head noun and the gap. The greater the number, the more difficult it is to process. When the verb exhibits AV, the word order can either be VSO or VOS. Meanwhile, when the verb exhibits PV, the word order can only be VSO. We use these word order possibilities to approximate the number of linear interveners between the head noun and the gap, represented by circled numerals, for head-initial and head-final RCs in 8 and 9, respectively.

(8) *Head-initial RCs*

a. Head ① Verb.AV ___ Object — *Linear distance = 1*

b. Head ① Verb.AV ② Object ___ — *Linear distance = 2*

c. Head ① Verb.PV ② Subject ___ — *Linear distance = 2*

(9) *Head-final RCs*

a. Verb.AV __ ① Object Head — *Linear distance = 1*
b. Verb.AV Object __ Head — *Linear distance = 0*
c. Verb.PV Subject __ Head — *Linear distance = 0*

In head-initial RCs, the linear distance between the head noun and the gap in SRCs can either be 1 or 2, as in 8a and 8b, respectively, depending on which word order is used to calculate linear distance. The distance in ORCs is 2, as in 8c. A conservative estimate predicts neutralization because the distances in 8b and 8c are equal. On the other hand, a more liberal estimate predicts the expected asymmetry because the distance in 8b is smaller than that in 8c.

In head-final RCs, the linear distance between the head noun and the gap in SRCs can either be 1 or 0, as in 9a and 9b, respectively, depending on which word order is used to calculate the distance. The distance in ORCs is 0, as in 9c. A conservative estimate predicts a reversal of the asymmetry because the distance in 9b is greater than that in 9c. On the other hand, a more liberal estimate predicts neutralization because the distances in 9b and 9c are equal.

Main clause similarity. Recall that the main clause similarity view relates processing difficulty to be a function of how similar the order of the RC is to the order of the main clause. The more similar they are, the easier it is to process. As already discussed above, Tagalog word order varies by voice. When the verb exhibits AV, the order of the elements can either be VSO or VOS. Meanwhile, when the verb exhibits PV, the order of the elements can only be VSO.

Accounts emphasizing the role of main clause similarity predict an asymmetry in head-initial RCs and neutralization in head-final RCs. In head-initial RCs, comprehenders have access to a main clause order where S precedes O (i.e., in VSO), which is the order of elements in a head-initial SRC. However, they have no access to a main clause order where O precedes S, which is the order of elements in a head-initial ORC. In head-final RCs, comprehenders have access to a main clause order where S follows O (i,e, in VOS), which is the order of elements in a head-final SRC. Similarly, they also have access to a main clause order where O follows S, which is the order of elements in a head-final ORC.

4.6. Results

In Figure 2, we report the breakdown of their responses by accuracy and confidence. We found a main effect of ORDER ($p < .001$), which suggests that participants were more accurate and confident in head-initial RCs than in head-final RCs. We also found a main effect of PARSE ($p < .05$), which suggests that participants were more accurate and confident in SRCs than in ORCs. These effects were qualified by a significant ORDER×PARSE interaction ($p < .05$). Participants were more accurate and confident in SRCs than in ORCs when the RC was head-initial than when the RC was head-final. Pairwise comparison of SRCs and ORCs in head-initial RCs indicate that SRCs were rated more accurately and confidently than ORCs ($p = .01$). Pairwise comparison of SRCs and ORCs in head-final RCs indicate no difference between SRCs and ORCs ($p = .43$)

In Figure 3, we provide a plot of the RTs of the participants' correct responses. We found a main effect of ORDER ($p < .001$), which suggests that participants were faster at offering correct interpretations when the RC was head-initial than when it was head-final. We also found a main effect of PARSE ($p < .05$), which suggests that participants were faster at offering correct SRC-interpretations than correct ORC-interpretations.

Figure 2: Breakdown of participants' responses by accuracy and confidence. Negative values on the x-axis indicate incorrect responses, while positive values indicate correct responses. High values (3) indicate high confidence in their response (irrespective of accuracy), while low values indicate low confidence in their response.

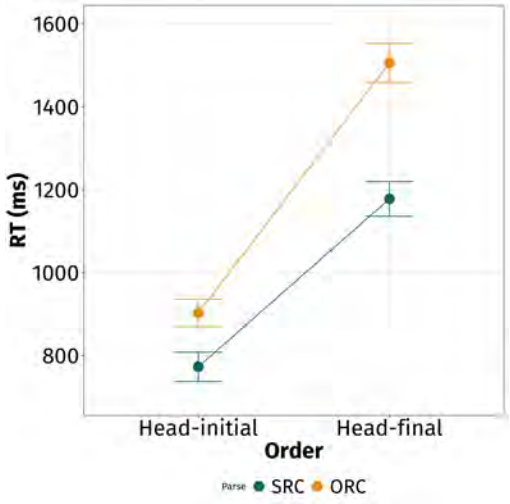

Figure 3: RTs of correct responses.

In short, we found the following: Analyses of the choice data suggest an asymmetry in head-initial RCs, but there is no evidence for an asymmetry in head-final RCs. Analyses of the RT data, on the other hand, suggest an asymmetry in both head-initial and head-final RCs.

5. General discussion and conclusion

In this paper, we asked the following questions. First, do we observe the asymmetry in Tagalog? Second, if we do, can other factors word order modulate this? We found that participants were more accurate and confident in SRCs than in ORCs when the RC was head-initial. Meanwhile, they were as accurate and confident in SRCs as they were in ORCs when the RC was head-final. They were also faster at providing correct SRC-interpretations than ORC-interpretations. These results add to

the body of literature showing that Tagalog exhibits the classic asymmetry, replicating the earlier findings about Tagalog head-initial RCs (Pizarro-Guevara 2014; Bondoc et al. 2018; Tanaka et al. 2019). These results also add to the growing body of literature showing that word order does attenuate the asymmetry, echoing Wagers et al. (2018).

What do these patterns of results tell us about the classes of explanations? Framed differently, which proposal(s) fared best? If we treat the various proposals to account for the asymmetry as inert, our findings cannot be accounted for by any single proposal. In places where one account could explain the asymmetry in one condition/measure, it would be unable to explain the attenuation in another condition/measure. For example, when the RCs involved were head-final, structure-based accounts fared well in capturing the asymmetry in the participants' RT data, but not very well in capturing the attenuation in their choice data. On the other hand, accounts emphasizing main clause similarity fared well in capturing the attenuation in their choice data, but not very well in capturing the asymmetry in their RT data. Refer to Table 2 for an overview of how each account fared, assuming that these proposals are inert and do not interact with one another.

Table 2: An evaluation of how each account fares compared against the results. A "✓" indicates that the prediction of a given account is consistent with the results. A "✗" indicates that it is not consistent with the results. A "()" indicates that it may be consistent, but with some qualifications.

Account	Order	Prediction	Choice	RT
Structural	Head-initial	Asymmetry	✓	✓
locality	Head-final	Asymmetry	✗	✓
Linear	Head-initial	Neutralization[a]/Asymmetry[b]	(✓)[b]	(✓)[b]
locality	Head-final	Reversal[a]/Neutralization[b]	(✓)[b]	✗
Frequency	Head-initial	Reversal	✗	✗
	Head-final	Reversal	✗	✗
Main clause	Head-initial	Asymmetry	✓	✓
similarity	Head-final	Neutralization	✓	✗

[a] is a more conservative estimate of linear distance; [b] is a more liberal estimate of linear distance

Perhaps a reasonable way to proceed would be to stop treating these accounts separately and instead argue for an integrative account where the asymmetry is a composite phenomenon. After all, language comprehension is a complex phenomenon that involves coordinating multiple sources of information. If we accept that these different classes of information all contribute in some way to the asymmetry, then the question becomes one of "when": When do they contribute to the difficulty? How are they temporally prioritized with respect to one another? Viewed this way, what we have painted then is an incomplete picture of the Tagalog facts, one that only shows their behavior in the final state of comprehension. To have a more nuanced picture of Tagalog RC-processing, we need to look at measures that allow moment-by-moment analyses (e.g., the participants' gaze data) to approximate when difficulties arise. At the time of writing, we are still in the middle of analyzing the participants' gaze data.

We acknowledge that the measures that we have analyzed might not have given frequency-based accounts their best chance to succeed. Recall that Nagaya (2019) found that ORCs are more

common than SRCs in the language, irrespective of word order. Accounts that emphasize the role of frequency would predict a reversal of the asymmetry. None of the measures indicated a reversal, however. Their gaze data could be informative of whether Tagalog comprehenders use frequency information when processing RCs.

Staub (2010) argued that frequency-based accounts predicted earlier difficulty, at the relative clause subject, in English. The reasoning is as follows: because SRCs are more frequent in English, after encountering the complementizer *that*, an SRC is a more likely continuation. When we see an overt subject, we are surprised and this causes processing difficulty. In an eye-tracking while reading study, Staub found that regressive saccades were much more likely from the subject noun phrase of an ORC. He interpreted this as being consistent with the predictions of frequency-based accounts. He also found longer reading times on the verb in ORCs. He interpreted this finding as being consistent with the predictions of memory-based accounts, another class of account that he was considering. Taken together, he maintained that both accounts contributed to the processing difficulty of ORCs. Crucially, they differed in terms of when the difficulty arose.

We could use the same reasoning for Tagalog RCs. Upon encountering the verb in an RC, Tagalog comprehenders might expect a verb with PV-morphology because an ORC-continuation is a more likely continuation due to its frequency. When they see AV morphology on the verb, they may be surprised and this could cause processing difficulty. In order to evaluate whether there is an *early* reversal in Tagalog RC processing, their gaze data could be informative.

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Proceedings of the Twenty-Seventh Meeting of the Austronesian Formal Linguistics Association (AFLA)

Henrison Hsieh and Keely New
(eds.)

AFLA XXVII
The Twenty-Seventh Meeting of the Austronesian Formal Linguistics Association

National University of Singapore (held online)
August 20-22, 2020

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