Scrutinizing adaptation: do people only adapt to infrequent discourse structures?

Simantika Roy[1], Elyce D. Johnson[1], and Jennifer E. Arnold[1], [1]UNC Chapel Hill

When interpreting ambiguous pronouns, people use the discourse context to infer the most likely referent. One strong constraint is the subject bias, for example in "Ana ate with Liz. She…", the preferred interpretation of "she" is Ana. Where does this bias come from? One hypothesis is that people learn to follow the most frequent patterns they encounter. This idea is supported by evidence that people tend to adapt to pronoun-reference patterns in the local context (Contemori, 2021; Kaiser, 2009). For example, Johnson & Arnold (2023) found that the subject bias was weakened when readers encountered a high frequency of unambiguous pronouns referring to the non-subject (e.g., "Matt ate lunch with Ana. She…."). But an open question is whether recent exposure has a uniform effect, or whether people only change their processing biases when they encounter unexpected input.

Research on adaptation to syntactic structures has shown that adaptation effects are stronger for exposure to rare syntactic constructions (Chang et al., 2006; Fine & Jaegar, 2013; Jaeger & Snider, 2013). For example, Thothathiri and Snedeker's (2008) showed that comprehension of a syntactic structure is facilitated after exposure to that structure. English speakers use the double object structure (DO: John gave his daughter a book) and the prepositional object structure (PO: John gave a book to his daughter). Upon priming with either of the aforementioned structures, the target sentence was adapted to the prime consistent structure. Fine et al. (2013) reanalyzed their data and found that the strength of adaptation was negatively correlated with how expected the upcoming input was. Adaptation was found to be stronger for the more unexpected structures compared to the expected structure, showing an inverse-frequency effect. We tested this in English.

For pronouns, the expected referent is the subject (Langlois et al., 2023) Corpus analyses also show that reference to subjects is more frequent than reference to nonsubjects (Arnold, 1998). Thus, pronouns with subject antecedents in an experiment may not be surprising, and may not induce adaptation. If so, we expect an inverse frequency effect: adaptation only where participants are exposed to pronouns with nonsubject antecedents.

Method: Following Johnson and Arnold's (2023) adaptation paradigm, there was a series of exposure stories (that had no pronominal ambiguity) interleaved with critical stories with ambiguous pronouns. We asked the interpretation of ambiguous pronouns, e.g. "Ana sent a text to Liz, and then she took a screenshot." The key question was how the rate of assigning "she" to Ana would vary based on recently-encountered exposure stories (see Table 1). In the neutral exposure stories (not tested previously), there were no pronouns. In the subject-exposure stories, unambiguous pronouns referred to the subject. In the nonsubject-exposure stories, unambiguous pronouns always referred to the nonsubject. Critically, the neutral condition served as a baseline to test whether adaptation occurs for both exposure conditions.

Experiment 1: (37 participants) tested in lab. The critical stories were tested with two types of questions: a question about the subject (Did Ana take a screenshot?) or a question about the nonsubject (Did Liz take a screenshot?) **Experiment 2:** (113 participants) took Mturk survey. The critical stories were tested with the 'who questions' as well (e.g. who took a screenshot?).

Results: Responses indicated whether there was a subject interpretation of the pronoun. Participants assigned the pronoun to the subject character of the ambiguous discourse in the subject reference exposure condition significantly more than in the non-subject reference exposure condition in both the experiments (Exp 1: p=.002; Exp 2: p<.001). Critically, no difference was observed between neutral exposure and subject exposure.

Conclusions: Participants have a baseline bias to assign pronouns to the subject character, perhaps due to a lifetime of encountering this pattern more frequently. When the low-frequency pattern is encountered repeatedly, it weakens this lifetime bias. This "inverse frequency effect" mirrors a similar effect for syntactic priming (Chang et al., 2006; Jaeger & Snider, 2008; Kim et al., 2014), suggesting that adaptation is modulated by prior experience.
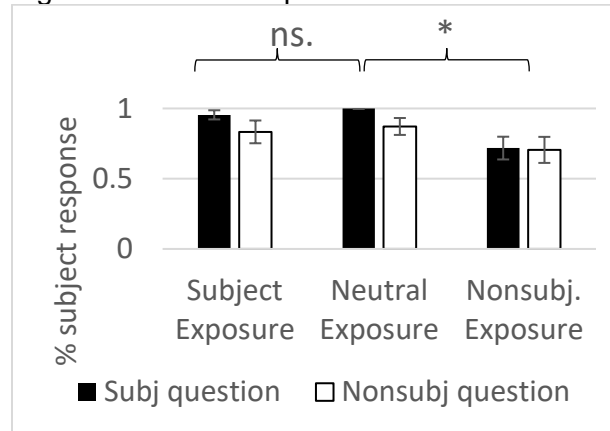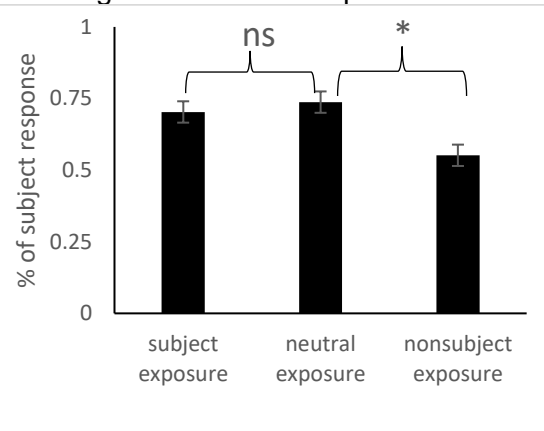
Figure 1. Results: Experiment 1

Figure 2. Results: Experiment 2

Example stimuli. Note that the reference question type was manipulated between items. Examples are shown with "who" type questions.

Condition	Examples
Subject exposure/He	Story: Will and Ana were spending the weekend together. Will set up a picnic in the park with Ana and then he ate some sandwiches. Reference Q: Who ate some sandwiches?
Nonsubject exposure/She	Story: Will and Ana were spending the weekend together. Will set up a picnic in the park with Ana and then she ate some sandwiches. Reference Q: Who ate some sandwiches?
Neutral exposure/Name (Liz)	Story: Will, Ana, and Liz were spending the weekend together. Will set up a picnic in the park with Ana and then Liz ate some sandwiches. Reference Q: Who ate some sandwiches?
Target (ambiguous)	Story: Ana and Liz were getting ready to go shopping. Ana brought the coupons to Liz and then she wrote a shopping list. Reference Q: Who wrote a shopping list?

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