Clefting and prosody affect pronoun processing in dialogue contexts
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Ambiguous personal pronouns in English are typically interpreted as co-referring with the subject and first mentioned referent; however, this interpretive preference is also guided by interactions with multiple discourse and pragmatic cues [1]. Although it is well established that linguistic focus marking can guide listeners' attention and memory for the focused part of the utterance [2], it is unclear whether this is used to help process ambiguous pronouns [3]. Using the visual world eye-tracking paradigm, we investigated the influence of linguistic focusing on both online and offline personal pronoun processing in English spoken dialogues. Linguistic focus was operationalized as prosodic marking additionally in the presence or absence of it-clefts. Crucially, this is the first study to do so whilst providing a felicitous discourse context that served to qualify the contrastive function of linguistic markers, namely to focus a referent relative to presupposed/established information. This reflects real-world use of linguistic focus.

Adults (N=58) listened to 20 spoken dialogues. In the experimental conditions, prosodic focus marking was either applied to the subject or object (8 and 8), with the focused character either being additionally it-clefted or not (Table 1). A fifth broad focus condition was included as a baseline. For all dialogues, Speaker A provided an introduction sentence (1) that named the subject, object, and two distractor characters (all depicted on the screen). Speaker B then asked a question that provided a felicitous context for each of the conditions; (2i) for the subject conditions, (2ii) for the object conditions and (2iii) for the broad focus condition. Speaker A's answer (3) provided the crucial focus sentence and was followed by the target pronoun *he.* With respect to the felicitous context, sentence (2i) for example, sets up a scenario where the new information in (3) is the subject, whereas for (2ii) the new information in (3) is the object.

> *(1) Last month at the meadow I saw a caterpillar, a bee, a spider, and a butterfly.*
> (2i) *Yeah, I heard someone tickled the caterpillar by the flower. Do you know who?*
> (2ii) *Yeah, I heard the caterpillar tickled someone by the flower. Do you know who?*
> (2iii) *Yeah I heard something happened. Do you know what?*
> (3) *The butterfly tickled the caterpillar by the flower. He wanted to lie down in the warm sunshine* (broad focus condition; see Table 1 for each condition).

We conducted a GAMM analysis [4] fit to subject advantage looks (looks to subject minus looks to object). Our online data (see Figure 1) revealed that linguistic focusing via prosodic marking enhanced subject advantage in the case of subject focus, and overrode it in the case of object focus, regardless of clefting. As can be seen in the left panel of Figure 1, these focusing effects were present prior to the pronoun (-200 to 400ms). In the case of subject focusing, subject advantage looks further increased upon the processing of the pronoun (at least 400ms onward). In the case of object focusing, subject advantage looks linearly increased across the analysis time window. These findings are in line with previous work showing that focused parts of utterances are boosted in terms of attention and memory representation [2], and further show that rather than a mere additive continuation, these effects combine with constraints specific to the pronoun itself. It should also be noted that the inclusion of object clefts meant that the object was fronted, thereby disentangling subject and first mention preference in English: a subsidiary analysis with the response variable set to first mention advantage supports the presence of both subject and first mention cues, and that preferences are more robust when aligned.

Offline interpretations showed no effects of focus. There was a ceiling preference for the subject in all conditions apart from when the object was fronted by a cleft. This suggests that, while multiple cues are processed, adults may have developed such robust preferences for subjecthood and first mention that these cues dominate in cases of conflict.

Table 1. *Test sentences for each condition; focused referents in bold print.*

Focus Condition	Example: Speaker A answer (test sentence and pronoun)
Broad focus	The butterfly tickled the caterpillar by the flower. He wanted to lie down in the warm sunshine
Subject focus-cleft absent	**The butterfly** tickled the caterpillar by the flower. He wanted to lie down in the warm sunshine
Subject focus-cleft present	It was **the butterfly** that tickled the caterpillar by the flower. He wanted to lie down in the warm sunshine
Object focus-cleft absent	The butterfly tickled **the caterpillar** by the flower. He wanted to lie down in the warm sunshine
Object focus-cleft present	It was **the caterpillar** that the butterfly tickled by the flower. He wanted to lie down in the warm sunshine

Figure 1. *Visualization of the summed effects derived from the GAMM of fixation patterns, with the random effects set to zero.*
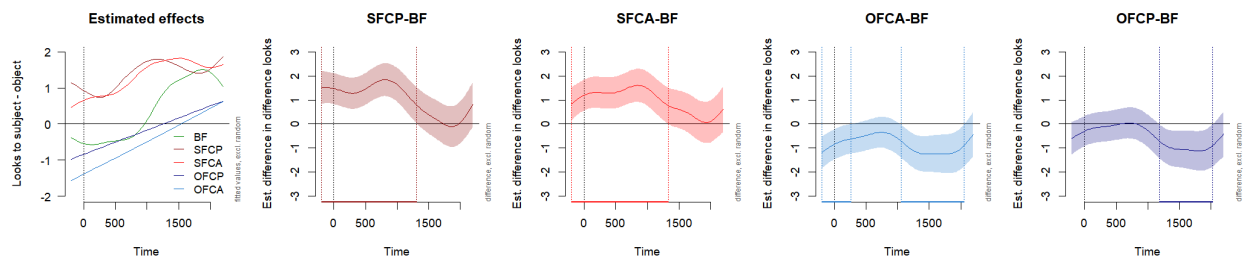
Notes. Left panel: Smooth terms for each time by condition term (0ms = pronoun, but effects due to pronoun constraints should be seen from at least 400ms onward). Other panels: Difference plots visualizing the difference between the broad focus condition with each other condition. A positive value indicates that the subject preference was greater relative to the broad focus condition.

References: [1] Arnold et al., (2000). The rapid use of gender information: Evidence of the time course of pronoun resolution from eyetracking. Cognition, 76, B13-B26. [2] Foraker, S., & McElree, B. (2007). The role of prominence in pronoun resolution: Active versus passive representations. *Journal of Memory and Language, 56,* 357-383. [3] Cowles et al. (2007). Linguistic and cognitive prominence in anaphor resolution. *Topoi 26*, 3-18. [4]. Van Rij et al. (2015). itsadug: Interpreting Time Series and Autocorrelated Data Using GAMMs. *R* package version 2.2. https://cran.r-project.org/package=itsadug