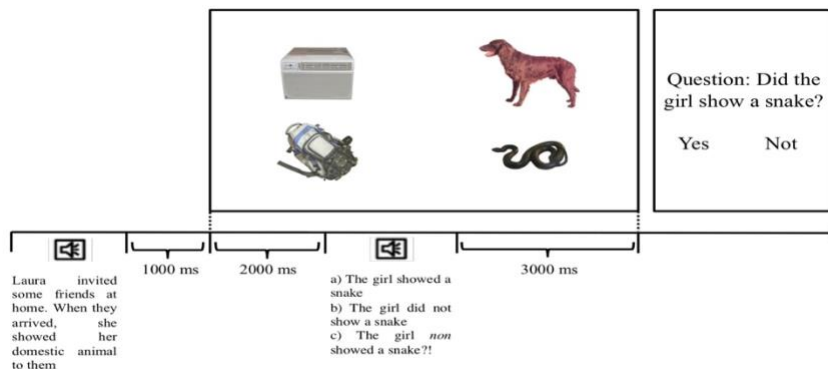


## Modulating “Surprise” with Syntax: a case study on Negative sentences

CLS session title: *Brain and Language - Linguistic subfield: psycholinguistics - Language: Italian- Keywords: negation, eye-movements, visual world paradigm*

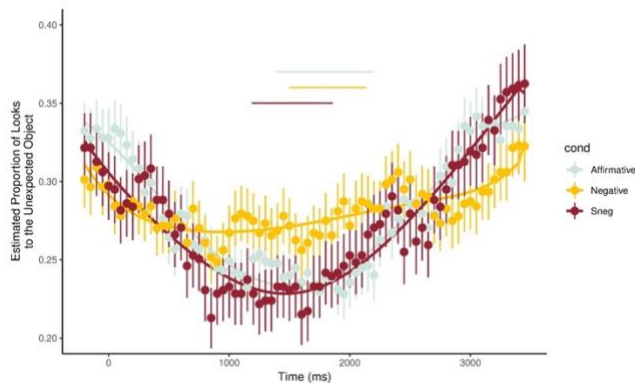
This work explores how a particular case of negative sentences, the *Surprise Negation Sentences* (SNEGs) (Greco 2018, 2019), is processed by measuring eye-movements in a visual world paradigm (Altmann & Kamide 1999; Salverda, Brown, & Tanenhaus 2011). SNEGs belong to the class of expletive negation sentences, i.e. they are affirmative in meaning but involve a clausal negation (Horn 1989; Jespersen 1917). An example is offered by Italian: ‘*E non mi è scesa dal treno Maria?!*’ (lit. and *neg* CL.to me is got off-the train Mary; ‘*Maria got off the train!*’). From a theoretical point of view, the interpretation of SNEGs as affirmative can be derived from their specific syntactic and semantic structure (Greco 2018). Here we use an established experimental paradigm to test for the first time how SNEGs are interpreted. We wanted to answer two empirical questions: (i) how is negation processed when it does not deny a sentence, as it is supposed to do? (ii) Are EN sentences elaborated either as affirmative clauses, according to their semantic value, or as negative clauses, according to their morphological shape? We had participants listening to short real-life stories. After the presentation of the initial context (e.g., *Laura invited some friends to her home. When they arrived, she showed her domestic animal to them*), four photos were displayed on the screen: the pictures represented two exemplars of the semantic category introduced by the story – varying for typicality (e.g., a *snake* vs a *dog* as atypical and typical domestic animals) – and two discourse-unrelated distractors (e.g., a *backpack* and an *air-conditioning system*) (**fig. 1**)



**FIG 1:** Experiment Time-line (the sentences are translated in English from Italian)

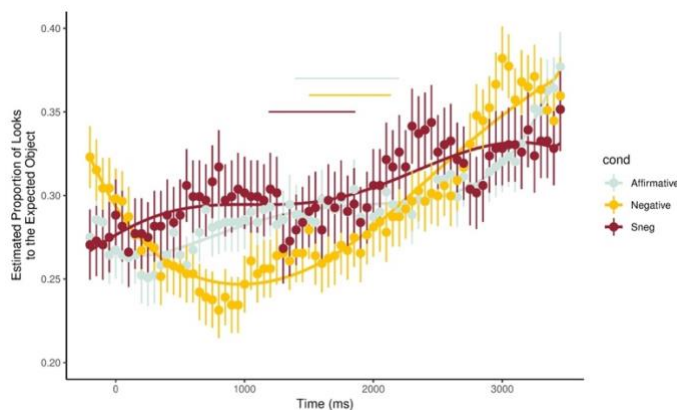
After 2000 ms the target sentence occurred, in three different conditions: affirmative (e.g., *The girl showed a snake*), negative (e.g., *The girl did not show a snake*) and Sneg (e.g., ‘*La ragazza non ha mostrato un serpente?!*’ translated as *The girl showed a snake!*). Because only two objects were compatible with the discourse context, this configuration provided a visual contest in which the differences between affirmative and negative clauses could emerge (Orenes, Beltrán & Santamaría 2014; Orenes et al. 2016). We expected to observe (i) an increased probability of fixating the mentioned (unexpected) object in both affirmative and Sneg sentences compared to negative ones; (ii) an increase in the probability of fixating the not-mentioned (expected) object in negative sentences, in a late time interval (Hasson & Glucksberg 2006; Giora 2006; Kaup, Lüdtke & Zwaan 2005, 2006). Overall, experimental predictions were confirmed by the Growth Curve Analysis (Mirman, Dixon & Magnuson, 2008) which showed that the fixation patterns to the relevant objects on the screen was very similar for affirmative and expletive negative sentences, while striking differences were observed between negative and affirmative sentences. More specifically, participants kept looking at the unexpected (mentioned) object (e.g. *the snake*) (**fig. 2**) after hearing the

negative particle in negative, but not in Sneg or affirmative sentences, as revealed by the effect of Sentence Type on the quadratic term of time [Neg vs Aff:  $-1.46$ ,  $t=-2.31$ ,  $p<0.05$ ].



**FIG. 2:** Fixation proportion to unexpected object during the target sentences; respectively, in grey for affirmative sentences, in yellow for negative sentences and in dark red for Sneg sentences. The offset of the 2<sup>nd</sup> word of each sentence is represented on the horizontal axis by 0. The three horizontal segments represent the moment in time when, on average, the sentence object was pronounced. Error bars depict Standard Error of the mean.

Coherently, the looks to the mentioned object quickly increased on the second half of the epoch (the inflection point of the fall-rise shape occurs during to the mention of the object) for both affirmative (e.g., *The girl showed a snake*) and Sneg cases (e.g., *The girl non showed a snake!*). With regard to the expected (not-mentioned) object (e.g. *the dog*) (**fig. 3**), participants moved their gaze away from it in negative sentences soon after the negative particle, as revealed by the effect of Sentence Type on the quadratic and cubic terms of time [Neg vs Aff quadratic:  $+1.21$ ,  $t=2.35$ ,  $p<0.05$ ; Neg vs Aff cubic:  $-0.78$ ,  $t=-2.16$ ,  $p<0.05$ ].



**FIG 3:** Fixation proportion to expected object during the target sentences; respectively, in grey for the affirmative sentences, in yellow for the negative sentences and in dark red for the Sneg sentences. The offset of the 2<sup>nd</sup> word of each sentence is represented on the horizontal axis by 0. The three horizontal segments present when, on average, the sentence object was pronounced. Error bars depict Standard Error of the mean.

Participants thus seem to build a representation of the most likely scenario early on (the domestic animal the girl will show is a dog), and negate it soon after the *non*; then, when they build the effective meaning of the sentence listening to it (*The girl did not show a snake*) they turn back to the *dog*, but this pattern of fixations occur only for negative and not for Sneg sentences, confirming our second prediction. These results showed that negation does play a different role in the mental representation of a sentence, depending on its syntactic derivation.

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