Measuring Implicature Computation and Cancellation in Japanese

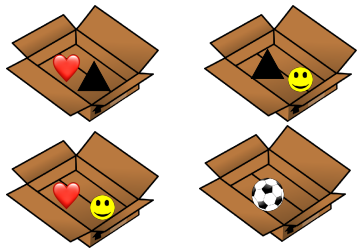
Two established generalizations about scalar implicatures are 1) their cancellation (or reversal) in downward entailing (DE) environments (Atlas and Levinson 1981, Sauerland 2004, and others), and 2) their immediate computation in online processing (Tanenhaus et al. 1995, Huang and Snedeker 2009, and others). Consider how this observations would apply to reading of the two structures sketched in (1). In (1a), where the operator that introduces a DE-environment precedes the scalar item in its scope, we expect that readers don't compute an implicature at all instead of computing it just to immediately cancel it. But in a structure where the scalar operator precedes the DE-operator as sketched in (1b), we predict that readers should first compute an implicature on the scalar item and subsequently cancel upon encountering the DE-operator.

(1) a. · · · DE-operator · · · scalar item · · ·
b. · · · scalar item · · · DE-operator · · ·

We carried out a study to measure the effect on reading times of implicature computation followed by cancellation in configuration (1b). We looked at Japanese since it allows several ways to create configuration in (1b) as a head-final language. Specifically, we targeted two types of conditional clause structures in Japanese illustrated in (2). In the variant (2a), the conditional is marked both initially by *mosi* ('if') and by the conditional verbal suffix *ireba*. But in variant (2b), the conditional is only marked by the conditional verbal suffix *ireba*.

(2) a. Sorezore-no hako-ni **mosi** haato-**ka** sumairii-ga tuite-ireba kurosu-ga tuiteimasu
every box-in COND heart-or smiley-NOM contain-COND cross contains
'In every box, if it contains a heart or a smiley, it also contains a cross.'
b. Sorezore-no hako-ni tiisaku haato-**ka** sumairii-ga tuite-**ireba** kurosu-ga tuiteimasu
every box-in PART heart-or smiley-NOM contain-COND cross contains
'In every box, if it contains a heart or a smiley, it also contains a cross.'

That the particle *mosi* in (2a) is really a conditional marked while *tiisaku* isn't is corroborated by the observation that (2b) would a grammatical sentence if it ends with the first *tuite* (i.e. before encountering *ireba*), while (2a) couldn't end grammatically before *ireba*. Hence (2a) is a structure of the (1a) type, while (2b) corresponds to the (1b) type.
The following image shows a critical context for the evaluation of the sentences in (2). If participants compute an exclusive implicature of *heart or smiley* locally, participants should just accept sentence of (2) as true. But if they cancel the exclusive implicature as we expect, participants are predicted to judge (2) to be false.

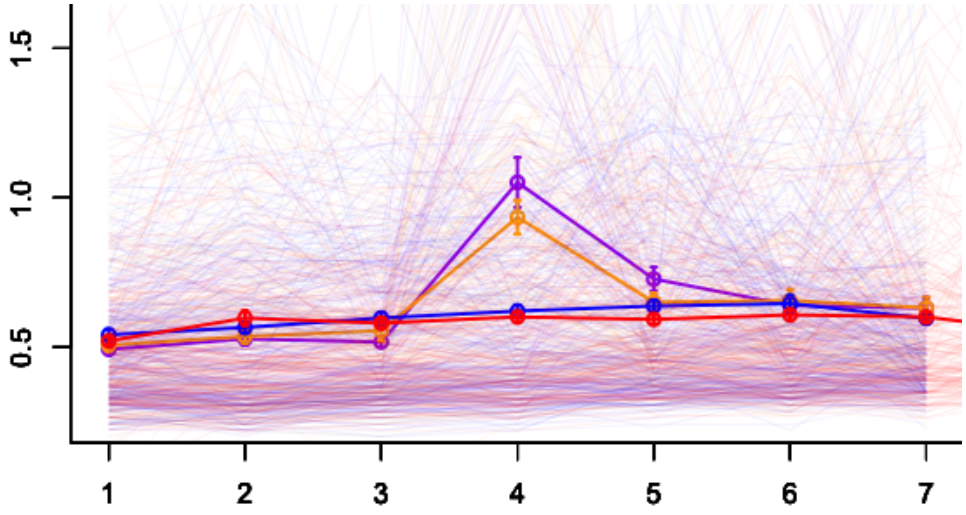


In our study, we asked participants to read sentences in a moving window presentation. After having read a sentence, participants were shown a picture such as the above on the screen and were asked to press a key for a true/false response. To control for the effect of the conditional structures, we included items such as (3) with both conditional structures, but without an implicature trigger. In addition, we included filler items that contained a disjunction but not a subsequent downward entailing operator to make sure that participants would not generally cancel implicatures throughout the experiment.

(3) a. Sorezore-no hako-ni **mosi** akai haato-ga tuite-ireba kurosu-ga tuiteimasu
every box-in COND red heart-NOM contain-COND cross contains
'In every box, if it contains a red heart, it also contains a cross.'

b. Sorezore-no hako-ni akai haato-ga tuite-**ireba** kurosu-ga tuiteimasu
every box-in red heart-NOM contain-COND cross contains
'In every box, if it contains a red heart, it also contains a cross.'

We created 10 items per condition and 115 fillers for a total of 155 items per participant.
Result: We report a preliminary result from 22 participants, but expect to be able to report a more conclusive result from a planned 60 participants by mid-September. In our preliminary data, the position of the DE operator had no effect on the rate of implicature computation, and that the majority of participants computed a (local) implicature. Namely for condition (2-a), participants responed true 87 out of 220 times, i.e. only in 40% of cases participants cancelled the implicature. For condition (2-b), the cancellation rate was 85 out of 220 cases, i.e. 39%. We take the absence of a significant difference here to argue that our processing systems decides where to carry out implicature computation and cancellation are carried out indepdent of the effort associated with it.
The reading time measurements show a small difference in the predicted direction that is not significant at this point. The data are shown in the following graphic where orange corresponds to (2-a), purple to (2-b), red to (3-a) and blue to (3-b). The critical region is region 4 which where the disjunction occured in (2-a) and (2-b). We observe a slowdown for (2-b) relative to (2-a) as our hypothesis would predict. The control conditions don't seem to show a comparable effect.



Conclusion We present an experimental study to measure the online processing effect of implicature computation and cancellation.

References

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