The production and processing of negation in concessive relations

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Seminal processing studies on negation revealed that negative sentences are difficult to process (e.g. Wason, 1959), as their understanding is taken to require an extra mental step. This two-step account of negation processing (Kaup et al., 2006) is challenged by other studies that take into account the licensing effects of some contexts, in which negation becomes less difficult (e.g. Nieuwland & Kuperberg, 2008). Polarity is also used as a binary dimension to classify discourse relations as either positive (such as cause or result) or negative (contrast, concession). In particular, concessive relations are sometimes described as "negative causal" (Köning & Siemund, 2000) because they involve the denial of an implied causal inference. Converging evidence from production and comprehension suggest that concession is indeed more complex (e.g. Xu et al., 2018) than positive relations.

The present study investigates the relationship between negation and concession, combining production (corpus) and processing (self-paced reading) data. From a production perspective, Asr & Demberg (2015) observed that negation markers are frequent in "comparison" (including concessive) relations. Here, we refine these results and report rates of negative verb polarity for several relations but also for several connectives that differ in their "strength" or information content, distinguishing between strong (e.g. *although*), intermediate (e.g. *but*) and underspecified connectives (*and*), following Crible (in press). This corpus-based study aims at establishing how strongly concession relies on negation marking.

From a processing perspective, the interaction between polarity and discourse relations has hardly been investigated, with the exception of Lyu et al. (2019), whose eye-tracking data suggests that negation is preferred in concession. Most other studies on negation compare linguistic contexts that make negation more or less difficult to process (e.g. Lüdtke & Kaup, 2006). By contrast, in this study, negation itself is viewed as a cue that helps comprehenders predict an upcoming concessive relation. The respective processing costs of negative polarity (compared to positive) and of concession (compared to result) are thus expected to interact such that negation will reduce reading times of concessive relations.

Corpus results. This study explores a sample of 2,000 connectives expressing either a negative (concession, contrast) or positive relation (cause, result, specification), from a corpus of spoken and written English (Crible, in press). The overt polarity of the verb (e.g. *don't*, *not*) in each argument of the relation was manually coded. Results show that negative polarity is most frequent in contrast (53%), followed by concession and result (around 45%), and is least frequent in addition and specification (around 29%). Focusing on concession and result, differences emerge across connectives: when concession is marked by (*and*), negation is more frequent (60%, including 45% in the second segment), whereas positive polarity (in both segments) is the most frequent configuration in result relations for all connectives.

Self-paced reading data: Experiment 1. Three hypotheses were tested: negative sentences are read more slowly than positive ones (H1); concession is read more slowly than result (H2); negative polarity speeds up RTs for concession (H3). For the self-paced reading experiment, 80 participants were recruited on Prolific. Materials from Crible et al. (forthc.) were modified to manipulate polarity, resulting in 40 critical stimuli (+ 40 fillers), in a fully counter-balanced two (positive vs. negative) by two (concession vs. result) design. Sentences were pre-tested for

plausibility and semantic similarity using LSA. The relations are read segment-by segment, and always connected by *and*, as shown in Table 1. A sense rating task follows each sentence.

The students had an upcoming exam./	They all **knew** their coursework well	/ and they /	were **confident**	/ about their performance.	/ PoRe
The students had an upcoming exam./	They **didn't know** their coursework	/ and they /	were **confident**	/ about their performance.	/ NegCc
The students had an upcoming exam./	They **didn't know** their coursework	/ and they /	were **anxious**	/ about their performance.	/ NegRe
The students had an upcoming exam./	They all **knew** their coursework well	/ and they /	were **anxious**	/ about their performance.	/ PoCc

Table 1. Example materials for the four conditions ("Positive Result", "Negative concession", etc.)

Reading times show a main effect of polarity on the first clause (before "and"), the connective region and the critical region, with faster RTs for positive sentences (cf. H1). Relation is significant on the critical and post-critical regions, with faster RTs in the result condition (cf. H2). Most importantly, there is a significant interaction between Relation and Polarity on the critical and post-critical regions, such that positive result is read much faster than the other three conditions. The difference in polarity for concessive relations never reaches significance, although RTs are longer for positive concession (1,053ms vs. 985ms) (cf. H3).

Time-course of negation processing: Follow-up experiments 2 and 3. Two follow-up experiments aimed at further measuring the time-course of the processing negation, by adding a fixed delay of 1,500ms before the connective region (Experiment 2, as in Kaup et al. 2006) or by adding a second post-critical region (Experiment 3, as in Lyu et al. 2019). These manipulations were expected to reduce RTs for negation. Both experiments replicated the main findings of Experiment 1, with no effect of delay on negative RTs.

Discussion. The corpus study suggests that negation is frequent in concession, particularly in the context of the weak connective *and*, where the rate of negation differs from result relations. This frequency in production, however, is not reflected in reading times: while positive polarity appears to have a facilitating effect for result relations, there is no preference for negation in concession. Manipulating the delay or the number of post-critical regions proved this pattern robust across replications. These findings suggest that negation cancels the processing difference between result and concession (i.e. when both are negative). The lack of difference between positive and negative concession could be due to a ceiling effect of complexity, which could be addressed by using more time-sensitive measures. Further manipulations of polarity in the experimental materials to better reflect the corpus-based pattern (e.g. negation in the *and*-clause) might also lead to results more in line with the production data.

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