1 Processing Discourse Relations

A large number of experiments reveals that language comprehension is generally incremental and even predictive (e.g., Tanenhaus & Trueswell, 1995). However, there is also evidence that incoming information across the sentence level does not always immediately update local predictions and affect global interpretation (Sanford & Garrod, 1998). The question therefore is which information from the discourse is considered, and how much and how fast it affects comprehension and active predictions by the comprehender. We report two studies which test whether discourse connectors are integrated quickly enough online to give rise to predictions, and in particular whether a concessive discourse connector leads to different predictions than a causal one. Comparing causal connectors (e.g., therefore) versus concessive connectors (e.g., however) is particularly interesting, because concessives have sometimes be referred to as “negative causals” (König & Siemund, 2000). Processing concessives (compared to causals) may resemble processing negation, leading to a delay in processing (e.g., Carpenter & Just, 1975) and giving rise to a search for alternatives (Knau et al., 2006).

2 Visual World Study

Participants were exposed to 60 trials (20 items, 40 fillers), each consisting of three spoken sentences and a static scene (see figure 1 and example (1)). The first sentence always introduced a topic (e.g., “food”). The second sentence identified a category (e.g., “sweet”), matching two of the depicted objects (cake and waffle). Two other objects in the scene belonged to another category (the counter category, salty foods: pretzel and cheese). The third sentence began either with a causal or a concessive connector and included the gender-marked pre-target noun region (die appetitliche “the delicious”), preceding the target noun (causal: waffle, concessive: pretzel). Target nouns were always congruent with the preceding discourse. All items and half of the fillers were followed by a yes/no comprehension question.


Marc fancies a snack. He feels like having something_topic [sweet]_category. [Therefore / Nevertheless, he gets]_connector [from the kitchen]_extended [die_fem / der_masc]_pretarget [waffle / cake / pretzel / cheese]_target.

Figure 1: Stimulus for visual world experiment.

Results Eye-movement data results (N=24) are shown in Figure 2 and reveal that when the category (sweet) was uttered, participants inspected the two objects matching this category (cake and waffle) significantly more frequently than the other objects. People were still most frequently inspecting these objects when the connector was uttered, but in the concessive condition started looking more to objects of the counter category (pretzel and cheese)
as the scope of the concessive was getting clear (region marked as connector in Example (1)). In the extended connector region (“from the kitchen”), we find significantly more looks to the counter-category objects in the concessive condition ($p < .001$) as well as still significantly more looks to the category objects in the causal condition ($p < .001$). This reveals that the concessive marker was immediately interpreted, and that people engaged in an active search for alternatives. In the pretarget region (when shifted 200ms)$^1$, the target (causal: waffle; concessive: pretzel) was looked at more frequently than all other objects in both conditions, and differences between target and gender competitor (the object that has the same grammatical gender as the target) as well as the unrelated competitor were significant at $p < .001$ in both conditions. In the causal condition, the difference between the target (waffle) to the category competitor (also sweet category, here: cake) is marginally significant ($p = .06$), while in the concessive condition, the difference between target (pretzel) and category competitor (cheese) is not significant ($p = 0.24$).

Figure 2: Results for causal (top) and concessive (bottom) conditions.

Discussion These results clearly reveal that both causal and concessive discourse markers were integrated rapidly into on-line comprehension and gave rise to predictions. In particular, processing the concessive led to a search for alternatives, and hence lead to different predictions than causal connectors. In the causal condition, processing was rapid and stable enough to combine with grammar information to also predictively identify the exact target referent. In the concessive condition, a similar tendency can be observed, but it did not reach significance. This may mean that processing concessions is more difficult and leaves less cognitive resources free for rapidly taking the gender marking into account.

3 Reading Study

A subsequent reading study with materials constructed according to a similar pattern, see Example (2), yielded however less clear results.


Lotte needs clothes to keep her head and neck warm for the winter. Her head and ears feel particularly cold. Therefore / However, she first of all looks for [a nicely warm]$^{gender-marked pretarget}$ [hat / scarf that does not look too colorful$^{target}$.

While we expected to see a mismatch effect (in terms of longer reading times) on the gender-marked pre-target region, when people would predict a specific noun based on the context and the discourse connector, and would be disrupted by a gender mismatch between their predicted noun and the gender of the adjective, we only found a significant effect in the causal condition and a marginal effect ($p < 0.06$) in the concessive condition, on a subset of 19 items for which an overall mismatch effect on the target region could be found.

Experiment 2 therefore indicates that, given that the discourse is really clear and constraining, in causally related sentences, readers are generally able to make predictions based on quickly integrating discourse context. In other words, if the target noun was predictable, then it was predicted rapidly (i.e., in the pretarget region). Global interpretation, as well, was influenced by the congruency of the discourse, as indicated by results from question answering accuracy. For concessives, on the contrary, there is no consistent evidence, that either of this was the case.

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$^1$This is frequently done in visual world studies with short regions because 200ms is known as the amount of time needed to program an eye-movement.
4 General Discussion

While results from Experiments 1 and 2 are not fully in line with one another, it is likely that prediction is easier with a constraining visual scene which is co-present during the entire discourse than with a linguistic context which is only read once and needs to be remembered and re-accessed. Moreover, while there was a prediction effect for concessives in the extended connector region in Experiment 1, prediction was also slower in the concessive than the causal condition (no significant effect in the concessive case in the pretarget region). Possibly, processing concessives was simply more slowly than processing causals in both experiments.

Possible explanations for the difference in results between experiments 1 and 2 are that a) concessives may be more difficult to process, and hence not leave enough resources for prediction, or b) that failure so show a mismatch effect is due to the scope of the concessive being more ambiguous than the scope of causals. In the causal case, the causal connector can only refer to the previous sentence. In the concessive case, the concessive marker might take scope either over the second sentence, in which case the prediction would be our target. But, it is also possible for the concessive to take scope over both initial sentences, leading to a prediction that Lotte goes on to do something entirely different. In that case, the space of possible predictions is wide open and cannot be expected to cause a gender mismatch effect. Note that such interpretations cannot be measured with the setup of the small visual world in experiment 1.

Results from Experiments 1 and 2 are generally in line with studies revealing immediate interpretation of discourse markers (e.g., Traxler et al., 1997). However, our data also supports that negating a discourse relation (i.e., via adversative markers) may cause a delay in processing, at least when a directly mentioned state of affairs needs to be rejected and its opposite needs to be both mentally accessed and found (on a scene or in memory). That means that concessive discourse markers are a type of negation that can cause processing difficulties. Moreover, Experiment 1 supports that negation can give rise to a search for alternatives (Kaup et al., 2006).

5 Conclusions

We investigated the time-course of processing marked causal and concessive discourse relations within two experiments. Results from a visual world experiment provide clear evidence that, at least in this highly constraining scenario, both causals and concessives can be processed incrementally and give rise to predictions. Concessives elicit an active search for alternatives. A reading experiment confirms this finding for causals but not for concessives. Results of both experiments indicate that concessives may be more difficult to process than causals, causing a delay.

References