Offline effects but no online differences in phrasal meaning composition including intersective vs. subsective adjectives

How the brain computes the meaning of complex expressions from the meanings of its parts is a central question in psycholinguistics. In meaning composition, context-sensitivity plays a crucial role, a variable that is also well-studied in formal semantics, especially in the adjectival modification literature (Solt, 2018). In two EEG experiments, we investigated noun-phrase composition with context-insensitive (intersective) and context-sensitive (subsective) adjectives. Crucially, the interpretation of subsective adjectives (e.g., fast/slow, big/small) depends on the meaning of the head noun. Moreover, these adjectives cannot be interpreted without taking some relevant comparison class into consideration. Contrary, the meaning of intersective adjectives (e.g., color and shape) is more constant also if presented in isolation (or a minimal phrasal context). Given this distinction in the linguistic literature, we tested whether adjective-noun phrase composition in Bokmål Norwegian including an intersective vs. subsective adjective leaves a distinct neural signature. Moreover, we manipulated the Typicality of the adjective-noun combination, a manipulation common in psycholinguistics but usually employed within a sentential or discourse context rather than on a phrasal level. Our study design included four experimental conditions: *intersective typical* (a green turtle), *intersective atypical* (a pink turtle), *subsective typical* (a slow turtle) and *subsective atypical* (a fast turtle). In two baseline conditions, we replaced the adjective with a non-word or a pseudo-word, while maintaining the same critical noun as in the semantic conditions (turtle). A word-by-word presentation of each phrase was followed by two questions. These questions aimed to assess both our Typicality and Denotation (subsective/intersective) manipulation, i.e., 'Is it a common [N]?' (Typicality); 'Is it a [adj] [superordinate category]?' (Denotation). Importantly, with the Denotation question we aimed to provide a context in form of a comparison class (animal). The non-word and pseudo-word trials were followed by one question to ensure that participants are paying attention: 'Is it a [superordinate category]?' (see Table 1 for correct responses based on the intersective/subsective distinction found in the linguistic literature). In Experiment 1, *no* instructions were given on how to answer the questions. The behavioral data showed that without any explicit instructions, participants predominantly applied an intersective reading to phrases including subsective adjectives (also discussed in Morzycki, 2015). This was evident in the responses of the Denotation question in the *subsective atypical* condition where in the majority of trials (78%) participants indicated that a 'fast turtle' is a fast animal. ERPs time-locked to the visual onset of the nouns did not show an effect of Denotation indicating no online differences in phrasal meaning composition. Based on these behavioral responses, we conducted a second EEG experiment where we gave participants instructions on how to answer the questions, e.g., 'Is it a fast animal?' NO – because fast turtles are not fast compared to many other animals. Moreover, participants got feedback on whether they responded correctly. Adding these instructions and the feedback, substantially increased the accuracy rate, especially in the two subsective conditions indicating a subsective reading of the phrases. Response time analyses of the Typicality question showed a main effect of Typicality, with faster RTs for Typical trials than for Atypical trials, and a main effect of Denotation, with faster responses for Intersective than Subsective trials as well as a significant interaction of these two factors. The same effects were found when analyzing RTs for the Denotation question. Despite these offline differences, no ERP effects of Denotation and Typicality (as in Experiment 1) were found. We only found significant ERP effects between the semantic and non-semantic conditions, i.e., between trials where the adjective was a real word, as opposed to a pseudo-word or a non-word. This comparison revealed a larger P600 component in response to nouns in the semantic conditions.

Enforcing a subsective reading of the phrase in Experiment 2 did not elicit any ERP effects of Denotation either, indicating that this lexico-semantic information is not part of the compositional operation, contradicting analyses in the linguistic literature. Moreover, in neither experiment did we find ERP effects of Typicality as predicted by the psycholinguistic literature (Federmeier, 2007). Possibly, we did not find any ERP effects because the phrases were not embedded within a wider sentence context. With our minimal phrase paradigm, predictability of the noun was kept at a minimum, a factor that previous studies found to be crucial for semantic composition and integration. Finally, the signature of semantic composition evidenced by a larger P600 component in semantic trials vs. non-semantic trials indicates that semantic composition occurs in a late time-window, i.e. ~450-700 ms post stimulus onset. These findings are in line with the hypothesis that syntax-driven meaning composition modulates the P600's amplitude (Baggio, 2018), and with proposals relating the P600 to operations at the syntax-semantics interface (Kuperberg, 2007).

References

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Table 1

Det.	Adj	↓EEG	Composition	Denotation Question	Typicality Question
en *a*	xkqh [nonword]	skilpadde *turtle*	Syn− Sem−	Is it an animal?	
en *a*	tæff [pseudoword]	skilpadde *turtle*	Syn+ Sem−	Is it an animal?	
en *a*	grønn *green*	skilpadde *turtle*	Syn+ Sem+ [Adj N]=[Adj]∩[N]	Is it a common turtle? **Yes**	Is it a green animal? **Yes**
en *an*	rosa *pink*	skilpadde *turtle*	Syn+ Sem+ [Adj N]=[Adj]∩[N]	Is it a common turtle? **No**	Is it a pink animal? **Yes**
en *a*	langsom *slow*	skilpadde *turtle*	Syn+ Sem+ [Adj N]⊆[N]	Is it a common turtle? **Yes**	Is it a slow animal? **Yes**
en *a*	rask *fast*	skilpadde *turtle*	Syn+ Sem+ [Adj N]⊆[N]	Is it a common turtle? **No**	Is it a fast animal? **No**