Processing correlates of action verb specificity

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Action verbs differ in whether their lexical meaning specifies how the action is carried out or leaves it unspecified. For example, the lexical meaning of the German verb *verzieren* (to ornament) denotes fairly unspecifically a process of decorating sth. with ornaments. The ornamenting process comes about an action of the agent, but the verb entails no precise information how the agent performs the action. In comparison, the German verb *besticken* (to embroider), denoting likewise a process of ornamenting sth., entails information how the agent creates the ornaments: he/she does decorative needlework.

Previous research on verb processing has given little attention to effects of semantic specificity. Findings from related research make two hypotheses conceivable on how semantic specificity could influence on-line verb processing. **HYPOTHESIS 1:** Semantic specificity is an instance of semantic complexity and should slow down verb processing (similar to effects reported in Gennari & Poeppel, 2003, where semantic complexity was manipulated in terms of event structure complexity). **HYPOTHESIS 2:** Semantic specificity allows one to represent the verb concept in multiple codes, including an image codes and/or stored action simulation in addition to the verbal code. Multiple-codings of a concept should facilitate meaning comprehension and speed up verb processing (cf. findings in Palazova et al., 2013; Marino et al., 2012).

The reasoning of the first hypothesis is that “more complex meanings (more entailed properties)” take longer to be processed because more semantic structure needs to be encoded, accessed and activated (Gennari & Poeppel, 2003:B29). Evidence for such a correlation between the complexity of the semantic structures and processing times is provided by the study of Gennari & Poeppel (2003). They contrasted event verbs like *build* with stative verbs like *love*. According to Levin & Rappaport (2005), event verbs have a more complex semantic structure than stative verbs. They include a higher number of semantic components, e.g. CAUSE and CHANGE, and more sub-events. The findings of Gennari & Poeppel (2003) demonstrated that more time is required to process the complex semantic structure of event verbs (vs. simple structures of stative verbs) for both infinitives and finite verb forms. If the relevant point in semantic complexity is indeed that the semantic structure has “more entailed properties” (of any kind,), an increased number of method details should also elicit complexity effects, i.e. longer processing times, compared to structures with less method details.

The second hypothesis is mainly motivated by cognitive theories on language comprehension like the dual coding theory and embodied cognition theories. However, also some discussions in the theoretical semantic literature touched on an idea implicit in the cognitive approaches. For example Rapp (1997) argued – although in a different context – that action-specific verbs make the activity more prominent than action-unspecific verbs due to the increased information about the agent-specific manners of action. Higher prominence typically correlates with faster processing times, for example demonstrated by Levelt et al. (1978) who found faster processing times for verbs with a salient movement component compared to verbs with a less salient activity.

The dual coding theory argues that concrete concepts are represented by a verbal code and a non-verbal code, a mental image of the concept, whereas abstract concepts
have only the verbal code (Paivio, 1986). The findings of Palazova et al. (2013) demonstrated that an additional image code can facilitate verb processing (faster RTs for concrete verbs than for abstract verbs). The imagery of concrete concepts makes two processing routes simultaneously available from a certain point in time during verb processing (semantic processing plus image-based processing). We expect that semantic specificity affects the concreteness of verb concepts and, thereby, the availability of an image code: specific verbs should allow for a precise mental image of the action, whereas unspecific verbs allow only for a vague image, if any.

Embodied cognition theories postulate that linguistic expressions have multimodal mental representations, potentially including representations in the perceptual, motor and emotional domain (e.g., Barsalou, 2008). For action-related concepts, one relevant modality is the sensorimotor domain. The involvement of sensorimotor areas in early stages of lexico-semantic processing of action verbs has been demonstrated by several studies (e.g., Kemmer et al., 2008). Interestingly, the findings of van Dam et al. (2010) demonstrated that the neural responses in the motor area are stronger for specific than for unspecific action verbs. If a stronger activation in the motor system due to a more precise action simulation indeed facilitates verb comprehension, specific verbs should be processed faster than unspecific verbs due to their sensorimotor specificity.

We tested the two hypotheses on semantic specificity effects in two behavioral experiments. We investigated processing times of specific and unspecific German action verbs in isolated presentation (Exp. 1) and in contextual embedding (Exp. 2).

Experiment 1 (n subj=27, n items=48) investigated single-word processing times of specific and unspecific German action verbs, e.g., besticken (to embroider) vs. verzierten (to ornament), in a visual lexical decision task. Verb pairs were selected such that the specific verb semantically entails the action described by the corresponding unspecific verb. Only the specific verb specifies a concrete method by which the action is carried out. Verb conditions did not differ significantly in other confounding variables (e.g., word length, lemma frequency, familiarity).

The results of experiment 1 revealed significantly longer response latencies for specific verbs (17 ms longer than for unspecific verbs, main effect in a likelihood ratio test of LME-models). The findings demonstrated first of all that verb specificity has indeed processing correlates. Furthermore, the findings indicated that processing correlates of semantic specificity resemble processing correlates of semantic complexity as found for event verbs. Thus, we argue in the same line. The longer processing times for specific verbs reflect that the encoding and activation of the semantic structure were costlier for specific verbs. Their semantic structure is more complex due to the increased method information compared to unspecific action verbs with almost no method information in the semantic structure).

In Experiment 2 (n subj=40, n items=24), short contexts with specific vs. unspecific German action verbs were presented for self-paced reading (word-by-word in a stationary window), see example (1). The short contexts were identical for both verb conditions except for the critical action verb in the first sentence. The agent of the action was always named initially by a proper name and continued as agent.

(1)  Jasper bestickt | verziert das Sofakissen. Er hat dafür ein edles Design entworfen. (Jasper is embroidering | ornamenting the scatter cushion. He has created a fancy design for it.)
The results of experiment 2 revealed that processing correlates of verb specificity go into reverse when verbs were embedded in sentences. We found a trend for shorter processing times for specific verbs compared to unspecific verbs (slightly shorter for low frequent verbs, about 30 ms shorter for high frequent verbs, p=.08). The results suggested that additional non-verbal codes are part of the mental representation of specific verbs, in line with embodied approaches. Additional codes can facilitate verb comprehension, at least when the verbs are processed in their sentential position.

We will discuss the different findings in the two experiments as a reflection of the contextual influence on verb processing. In experiment 2, the specific verbs were encountered after reading a nominal phrase very likely denoting the agent of the action. Knowledge about the agent at the time when specific verbs were processed enables the reader to apply the agent-specific method information immediately to the agent representation. Thereby, agent and action representation become densely connected; this might immediately enhance the imagery and simulation of the action and boost the activation of the non-verbal codes. In contrast, in experiment 1, the activation of mental images and sensorimotor codes were neither boosted nor especially required by the task. The verbs were presented as neutral infinitives and no information about event participants was available. As a result, the image and sensorimotor codes of specific verbs might be, if at all, weakly activated during verb processing. Thus, verb comprehension was presumably mainly based on the verbal code of the verbs.

In sum, the findings of our two experiments provided evidence that verb specificity has processing correlates in on-line comprehension. The results suggested that semantic specificity of action verbs as such is a type of semantic complexity correlating with longer processing times, but as soon as image and/or sensorimotor codes of specific verbs become salient, verb processing seems to benefit from semantic specificity.


