**Meaning (Mis-)Match in the Directionality of German Particle Verbs**

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German particle verbs (PVs; e.g., *an-schieben* 'push sth. forward') are highly productive and ambiguous complex structures that combine a particle such as *an* with a base verb (BV; *schieben* 'push'). They often trigger meaning shifts of the BVs [1-2]. For example, while *an-schieben* emphasizes the horizontal direction of the pushing event *schieben*, the PV *auf-schieben* expresses a non-literal meaning ('postpone').

**Hypothesis** Our work investigates the directionality of the particles *an* and *auf*. We hypothesize that the particle *an* is primarily associated with a horizontal directionality, and *auf* with a vertical directionality. Consequently, combining the particle *an* with BVs that incorporate a horizontal direction (such as *schieben*), we expect a match between the particle and BV meanings (resulting in a literal PV). On the other hand, combining *an* with a vertical BV should result in a mismatch between particle and BV meanings (resulting in a meaning-shifted PV). Vice-versa for *auf*. Verbs in the match condition should be processed faster (facilitation) than verbs in the mismatch condition (inhibition).

**Item Selection** A group of native speakers (15 for each BV) classified 230 German BVs according to their most prominent direction (horizontal, vertical). From this set, we extracted all BVs with a preferred directionality (e.g., 79% of the time, *schieben* was classified as horizontal) and selected 11 horizontal and 11 vertical BVs that generate valid PVs in combination with both particles *an* and *auf*. The horizontal BVs were attached to *an* in the match condition and to *auf* in the mismatch condition; vice-versa for the vertical BVs.

An ANOVA test was performed to exclude purely frequency or associative effects between the two conditions (*an*, *auf*). No significant effect of frequency of the PVs (F(1,1) = 0.12, p = 0.75) or of cosine similarity between the BV and the PV (F(1,1) = 1.45, p=0.23) were found.

**Experiment** To test our hypothesis, we performed a go/no-go lexical decision experiment. The primes were the particles (e.g., *an*) and the targets were the base verbs (e.g., *schieben*). A question about the type of particle used as prime was asked after each experimental trial. 69 German native speakers took part in the experiment (23±3 yo; 12 females). 3 participants were discarded: 1 didn’t perform the required task, and 2 had reaction times (RTs) averaging 2.5 standard deviations above the grand mean.

**Quantitative Analysis** As shown in Figure 1, subjects are slower in processing a verb in the mismatch condition (768±8ms) than in the match condition (729±10ms). We performed a LMER analysis [3] using log-transformed RTs as the dependent variable of the model, *match/mismatch* as the main factor, and random slope and intercept under Item and Subject [4]. The model shows a significant difference between the two conditions (β$_{mismatch}$ = 0.05, p<.05).

**Qualitative Analyses** We performed a series of analyses by item. Figure 2 shows the differences between RTs in the mismatch and match conditions grouped by directionality: 15/22 verbs manifest a facilitation (positive values) for the match condition. The green bars in Figure 2 indicate whether the mismatch condition has higher abstract values than the match one [5]. We assume that a transition from literal to meaning-shifted readings is reflected in an increase in abstraction [6,7]: 13/22 verbs show this pattern. The red bars indicate cases where the PV in the mismatch condition is polysemous, in most cases including a shifted sense next to a synonym of the matching PV (e.g., *aufdrehen$_{meaning-shifted}$* 'exhilarate' vs. *aufdrehen$_{literal}$* ~ *andrehen* 'turn up').

**Discussion** Overall, this study strongly supports our hypothesis: it takes significantly longer to process a mismatching (inhibition) particle/BV pair than a matching (facilitation) pair. We conclude that the particles *an* and *auf* have a predominant horizontal/vertical directionality, respectively. Qualitative analyses showed that this effect can typically be attributed to meaning-shifted senses of (polysemous) PVs. Future work aims to incorporate the relation of meaning shifts and degree of PV polysemy into further investigations of particle directionality.
Figure 1: Average RTs (ms) and standard error for the match (e.g., an+horizontal BV, auf+vertical BV) and mismatch (e.g., an+vertical BV, auf+horizontal BV) conditions.

Figure 2: Differences in RTs (ms) between the mismatch and match condition for each BV (grouped by particle directionality). Positive values (bars on the right) indicate longer RTs for the mismatch condition than for the match condition. Abstraction differences are color-coded: green bars indicate that the mismatch condition has a higher abstraction score than the match condition; red bars indicate the opposite pattern. The grey bar marks a missing value.

References: