Effects of Register and Morphosyntactic Congruence on Eye Movements During Sentence Reading

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1 Introduction and Methods

In the last three decades of psycholinguistic research, it has become increasingly clear that various information sources are rapidly integrated for successful sentence comprehension, such as animacy [10], thematic role assignment [6], and morphosyntactic constraints [8, 9], as well as individual features of the speaker and comprehender [7]. The present eye-tracking studies aimed at exploring the effects on sentence processing of an under-investigated type of context information, i.e., variation in situation formality as conveyed by different linguistic registers. We borrow the definition of 'register' adopted within the CRC 1412, i.e., "[a set of] aspects of intra-individual variation in linguistic behavior that are influenced by situational and functional settings" (see [1]).

We investigated whether: (i) context formality information is rapidly integrated, as reflected by early eye-tracking measures; (ii) additive or interactive effects of register and morphosyntactic congruence emerge, reflecting respectively distinct or shared mechanisms/representation for formality-register congruence and standard language processing (see, e.g., [2]). Additionally, we explored whether different degrees of perceived formality (assessed through offline rating tasks) affect sentence processing. Eye movements were acquired from two groups of eight German native speakers (age range: 18-31). Items were comprised of two context sentences followed by a target sentence. Target sentences featured a subject noun phrase (*NP1*; e.g., *Der Polizist*, 'The policeman'), a verb in the third singular German past simple (e.g., *inhaftierte*, 'detained', high register, or *schnappte*, 'grabbed', low register), and an object noun phrase (*NP2*; e.g., *die Aktivistin*, 'the activist'). Context sentences conveyed a formal or informal social situation, permitting the manipulation of formality-register congruence, in a blocked presentation (counterbalanced). While the first study (Pilot A) only manipulated register congruence, in the second one (Pilot B) morphosyntactically incongruent conditions featured a target verb in the infinitive form (*inhaftieren,*

schnappen); pilot B thus featured a 2x2 design (factors: register congruence, subject-verb morphosyntactic congruence; levels: match, mismatch). Items were assigned to lists according to a Latin square. We predicted longer reading times at the verb region for mismatching verbs (under both manipulations), due to processing costs of incongruent information. We also expected potentially similar effects at the NP2/spillover region (see [8]). Linear mixed models were fitted to log-transformed *first-pass reading*, *regression path duration* and *total reading time* in two areas of interest: verb (target region) and NP2 (post-target, spillover). In Pilot A, the predictor in each model was *register congruence*, plus *average target sentence formality ratings* and *average context formality ratings* as covariates. In Pilot B, the predictor terms in each model were *register congruence*, *morphosyntactic congruence* and an interaction thereof, plus *average target sentence formality ratings* and *average context formality ratings* as covariates. Random intercepts were fitted to items and participants.

2 Results and Discussion

Pilot A: At the verb region, longer total reading time (Figure 1a) was observed for register mismatches (vs. matches, t=-2.05, p=.040, d=-.25), and for higher target sentence formality ratings (t=3.22, p=.001, d=.37; effects on earlier eye-tracking measures *n.s.*, interaction *n.s.*, post-verbal effects *n.s.*). **Pilot B:** At the verb region, main effects of the two factors also emerged in total reading time only. In line with patterns of overt syntactic violations, total reading time (Figure 1b) was longer for morphosyntactically mismatching (vs. matching) verbs (t=-1.98, p=.048, d=-.24). With respect to register congruence, contrary to the expected pattern (see Pilot A), verb total reading time was longer for matches (vs. mismatches, t=3.24, p=.001, d=.39; interaction *n.s.*, formality ratings effects *n.s.*). At the NP2 region, we found early effects of subject-verb morphosyntactic congruence (t=2.07, p=.038, d=.25), register congruence (t=-2.50, p=.012, d=-.31), and of their interaction (t=2.00, p=.045, d=.25) on first-pass reading (Figure 2a); formality ratings effects *n.s.*). Finally, longer NP2 regression path duration (Figure 2b) emerged following morphosyntactically mismatching verbs (vs. matching, t=-2.83, p=.005, d=-.35), register-matching verbs (vs. mismatching, t=2.55, p=.011, d=.31), and with higher average context formality ratings (t=2.45, p=.014, d=.29).

Discussion: In both pilots, effects of register and morphosyntactic congruence only emerged at a relatively late processing stage (indexed by total reading time) at the verb region, contrary to expectations of context information to rapidly inform processing. In Pilot A, the effect of formality-register mismatch was detrimental for verb processing times, in line with general accounts of social context and world knowledge in language processing (see, e.g., [5, 11]). In line with long-standing research on syntactic processing [3, 4], in Pilot B the effect of subject-verb morphosyntactic mismatch yielded longer verb reading time. When both factors were manipulated, the pattern of the register congruence effect was in the opposite direction relative to the predicted pattern and to that observed

in Pilot A. While this, too, remains to be further explored, it is suggestive of potential interference between the two processes, even in the absence of a visible interaction. In summary, the present pilot findings for the verb region suggest that context information and grammatical knowledge are integrated incrementally during sentence comprehension. At the spillover (NP2) region, effects of register and morphosyntactic congruence emerged at earlier processing stages. In first-pass reading, register congruence interacted with morphosyntactic congruence, almost acting as a 'filter' for its successful processing. Finally, regression path duration analysis at the spillover region displays a similar pattern to that observed for verb total reading time (Pilot B), and reflects a cost of higher context formality. Further data collection (*N=40*) is underway, and corpus-based analysis is planned, to investigate the effects of additional constraints (e.g., word frequency). Pending replication, these findings suggest that processing of register and of morphosyntactic congruence might indeed interfere to some extent.

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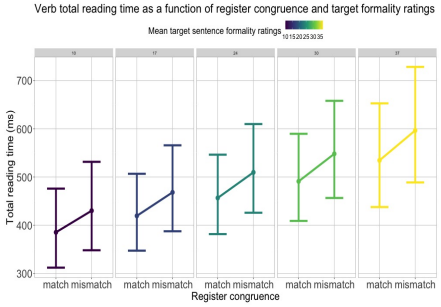
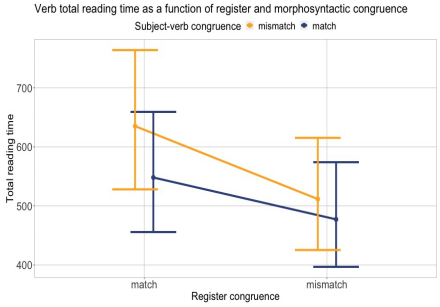
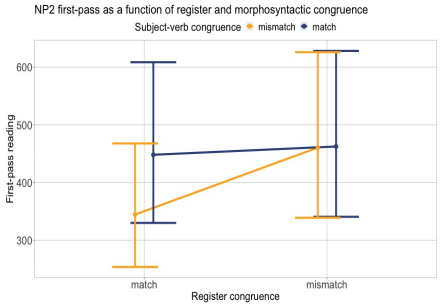


(a) Effects of register congruence and average offline target sentence formality ratings (scale from 0=very informal, to 50=very formal) on total reading time (in ms) at the verb region, in Pilot A. Error bars: 95% confidence intervals.

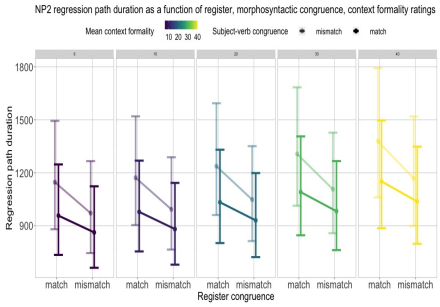


(b) Effects of register congruence and subject-verb morphosyntactic congruence on total reading time (in ms) at the verb region, in Pilot B. Error bars: 95% confidence intervals.

Fig. 1. Effects in the verb region. (a): Pilot A; (b): Pilot B.



(a) Effects of register congruence and subject-verb morphosyntactic congruence on first-pass reading (in ms) at the object (NP2) region, in Pilot B. Error bars: 95% confidence intervals.



(b) Effects of register congruence, subject-verb morphosyntactic congruence (match=full line, mismatch=shaded line) and average offline context sentence formality ratings (scale from 0=very informal, to 50=very formal) on regression path duration (in ms) at the object (NP2) region, in Pilot B. Error bars: 95% confidence intervals.

Fig. 2. Effects in the NP2 (spillover) region in Pilot B. (a): First-pass reading (b): Regression path duration.