Language learning and cognitive restructuring in bilingual French-German event processing

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Abstract

This study examines the influence of linguistic properties on cognitive processing of motion events in French-German sequential bilinguals (L2-speakers). Employing verbal production and categorization tasks paired with eye-tracking, the results indicate that L2-speakers overall align their Manner lexicalization with German L1-speakers. However, low-proficiency L2-speakers exhibit reduced Manner encoding for low-Manner-salient events (e.g., walking). While preparing to verbalize, L2-speakers' visual attention develops throughout the learning process: dwell time on Manner-salient areas increases with longer L2-immersion – even exceeding L1 patterns before stabilizing. In the categorization task, a trend towards more Manner-congruent choices with increasing proficiency did not reach significance, pointing to important individual variability. These findings suggest that cognitive restructuring requires extensive experience with the target language, is task-dependent, and develops progressively.

Keywords: motion event processing, French-German bilinguals, linguistic typology, eye-tracking, linguistic and cognitive restructuring.

Introduction

Languages exhibit substantial cross-linguistic variability in how motion event semantic components are encoded (Talmy 2000). Speakers of verb-framed (VF) languages, such as French, typically encode Path (P) within the verb, relegating Manner (M) to peripheral expressions or omitting it entirely—e.g., *Il traverse la rue (en courant)* ('he crosses the street (running)'). In contrast, speakers of satellite-framed (SF) languages like English or German encode M in the verb while using peripheral elements to represent P—e.g., *Er rennt über die Straße* ('he is running across the street').

Recent research has started to explore whether and to what extent such linguistic constraints influence cognitive processing and attentional mechanisms. Lupyan et al. (2020) suggest that language shapes cognitive representations, leading speakers of typologically different languages to perceive reality differently. For example, Soroli (2024) showed that typological differences between English and French influence spatial thinking, motion event categorization, and gaze behavior. French speakers prioritize P more than

English speakers, with differences not only in verbalizations, but also in similarity judgments and some measures of visual attention, additionally guided by the nature and salience of the target events, and by the degree of language involvement in the tasks. In the domain of second language (L2) acquisition, Flecken et al. (2015) showed that while typological differences between French and German extend beyond the verbal domain —e.g., French speakers focus on moving entities and P-endpoints, and German speakers prioritize M— advanced French learners of German adopt German-like M-verb encodings, but retain French-like pre-speech attention patterns, reflecting persistent L1 influences in L2 cognitive processing. Wang and Li (2021) found that multilingual speakers undergo some cognitive restructuring toward the target language in both linguistic encoding and non-linguistic conceptualization, but the degree of restructuring depends on the level of exposure, suggesting that language learning entails internalizing progressively a new way of thinking.

Despite increasing interest, little is known about how cognitive shifts unfold across language combinations, experimental paradigms, and bilingual profiles. This study examines whether acquiring a typologically different L2 affects only verbalization or also influences visual exploration and categorization. L2 acquisition may involve either a transfer of entrenched L1 patterns (Flecken et al. 2015), or gradual cognitive reorganization (Wang & Li 2021). By integrating linguistic and cognitive paradigms, this research investigates whether L1-French/L2-German bilinguals adopt L1-German patterns in verbalization, visual attention and categorization of motion events.

Methods

28 L1 German speakers (26 females) and 21 L1-French/L2-German bilinguals (14 females) participated (*M* age = 28, *range* = 19-68) in Production and Categorization tasks (cf. Soroli, 2024). Among the L2 participants, 10 were high-proficient (*M* Lextale score = 85, *SD* = 3.5) and 11 low-proficient (*M* Lextale = 69, *SD* = 5.1). Participants first completed a socio-demographic background questionnaire and the LexTALE German proficiency test (Lemhöfer & Broersma 2012), and then were tested in the verbalization task, where they had to describe 30 videos featuring an individual performing a motion event. These events involved different Ms (with and without instruments) and Ps (with zero, one or two boundary crossings). Eye movements were recorded at 1000Hz via an Eyelink Portable Duo and Dwell times on M-salient areas (e.g., legs of the individual and, when applicable, instrument used) were measured via dynamic areas of interest (AOIs). The second task was a categorization task, where participants had to judge similarity between a target video and two options: one M-congruent (same M, different P) and one P-congruent (same P, different M) variant. Participants' choices were recorded via button press.

Results

Data from the verbalization task were analyzed using generalized linear mixed models on M-encoding in verbs. Fixed factors included language group (L1, L2-high, L2-low), M-type (with, without instrument), and their interaction, with a random intercept for item and a random slope for M-type per subject. The interaction of language group and M-type significantly improved model fit ($\chi^2(2) = 6.26$, $p = .044$). Specifically, the L2-low group showed lower M-verb encodings compared to the L1 group ($b = -1.49$, $z = -2.74$, $p = .006$) for events involving an instrument, but not for motions without an instrument ($p > .05$). No differences emerged between the L2-high and L1 groups ($p > .05$).

Linear mixed models were conducted on dwell time spent in M-salient AOIs during preparation for verbalization, with language group, M-type and P-type (zero-, one-, two-boundary crossings) as fixed factors, a random intercept for item, and random slopes for M-type and P-type per subject. Results indicated significant effects of M-type ($b = 224.78$, $t = 2.32$, $p = .027$) and P-type ($b_{one\text{-}boundary} = -621.74$, $t_{one\text{-}boundary} = -5.94$, $p_{one\text{-}boundary} < .001$; $b_{two\text{-}boundary} = 362.82$, $t_{two\text{-}boundary} = 2.79$, $p_{two\text{-}boundary} < .001$), but no effect of language: the L2-high ($M = 1345$, $SD = 809$, $b = 7.47$ $t = .07$, $p = .945$) and the L2-low groups ($M = 1263$, $SD = 794$, $b = 39.49$, $t = .38$, $p = .707$) did not differ significantly from L1 speakers ($M = 1281$, $SD = 819$) with regard to M-AOIs. However, further analyses on bilinguals' data showed a significant effect of L2-immersion length (i.e., months spent in Germany) on dwell time in M-AOIs. Longer immersion was associated with increased visual attention to M-AOIs ($b = 419.83$, $t = 3.99$, $p = .003$), even exceeding the visual attention of L1 speakers to M, before stabilizing at L1 levels, after several years in Germany (see Figure 1).

The categorization data was analyzed using generalized linear mixed models on M-congruent choices with language group, M-type and P-type as fixed factors, and random intercepts for items and for subjects. Although a descriptive trend indicated higher proportions of M-congruent choices in the L1 ($M = .51$, $SD = .5$) compared to the L2-high ($M = .41$, $SD = .49$) and L2-low groups ($M = .36$, $SD = .48$), the effect of language group was not statistically significant ($p > .05$) due to important intergroup variability. Additionally, significantly more M-congruent choices were found for one-boundary compared to zero-boundary crossings ($b = 1.31$, $z = 3.21$, $p = .001$). For L2 participants, L2 immersion descriptively increased the probability of making a M-congruent choice, but this trend did not reach statistical significance in the mixed models ($b = .73$, $z = 1.57$, $p = .116$).

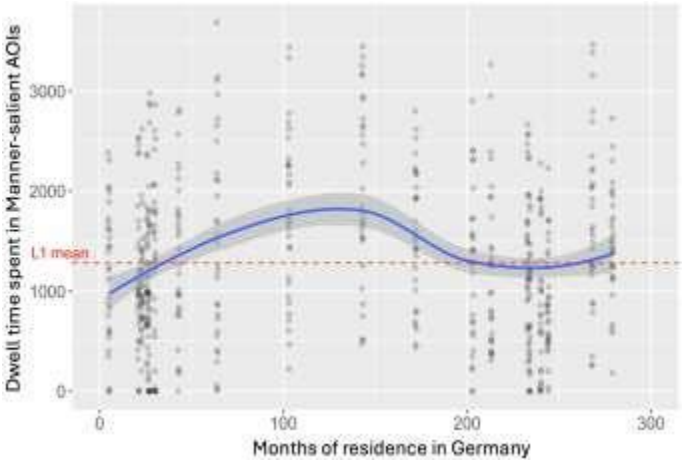

Figure 1. Dwell time on M-salient AOIs as a function of L2-immersion length.

Conclusion

The findings suggest that while L2-learners can approximate target verbalization patterns early in the learning process, aligning event cognition with target language patterns may require extensive L2 immersion. Additionally, event-specific characteristics, such as the type of M or P presented, may modulate both verbal and non-verbal behavior, independently of linguistic background. We conclude that reconceptualization is a dynamic process, impacting attention allocation and categorization, and that factors such as the salience and nature of events, as well as the extent of cumulative immersion in the L2, must be further considered when examining this process.

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