



Universiteit  
Leiden  
The Netherlands

## **Worlds shaped by words: a cross-linguistic investigation into the neural mechanisms of lexico-syntactic feature production**

Wang, J.

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## Summary

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In some languages, things in the world are linguistically categorised through nominal classification systems such as grammatical gender (e.g., in German, the noun for “book” is assigned neuter gender; in Dutch, the noun for “table” takes common gender) and classifiers (e.g., in Mandarin Chinese, “book” is paired with a classifier - *běn*; in Japanese, the noun “shirt” requires the classifier - *mai*). These systems are considered intrinsic properties of nouns, referred to as *lexico-syntactic features*. This dissertation adopts a cross-linguistic perspective to comprehensively examine how lexico-syntactic features are processed during noun phrase production. Speech production models, such as the *Levelt-Roelofs-Meyer* (LRM) model, propose that lexico-syntactic features are stored in the *mental lexicon* alongside a noun’s *lemma*. During language production, the activation of a conceptual representation leads to the retrieval of the corresponding lemma, which subsequently activates associated lexico-syntactic features. This assumption has been extensively examined in studies on grammatical gender in Indo-European languages, but evidence regarding classifiers remains relatively scarce. The activation pathway of lexico-syntactic features has been primarily proposed based on studies of regular nouns. It is still unclear whether this processing mechanism applies to non-canonical nouns, such as semi-lexical nouns that exhibit characteristics of both content and function words.

Grammatical gender and classifiers share comparable linguistic functions: categorising nouns and governing syntactic agreement with associated elements within a phrase. Thus, these features are often discussed jointly in the literature. However, the realisation of these syntactic functions may exhibit some discrepancies between grammatical gender and classifiers. In German, grammatical gender categorises nouns into masculine, feminine, and neuter. Gender assignment rules show arbitrariness and typically exhibit one-to-one mappings. Mandarin classifiers form mutual constraints with nouns based on semantic features (e.g., animacy, shape, function), displaying many-to-many combinatorial possibilities. Such linguistic differences may also be reflected in cognitive processing, potentially posing challenges for second language (L2) learners in acquiring unfamiliar lexico-syntactic features.

Focusing on noun phrase production, this dissertation explores the cognitive and neural processes involved in lexico-syntactic feature activation, assessing whether existing conclusions can be generalised to a broader range of lexical categories, typologically distinct languages, and speaker populations. To address these questions, we employ a multi-method approach combining behavioural measures (naming accuracy and naming latencies) with high-temporal-resolution

electroencephalography (EEG) for event-related potential (ERP) recording within established psycholinguistic paradigms: *picture-word interference* (PWI) and *blocked cyclic naming* (BCN) paradigms.

**Chapter 2** presents a picture naming experiment using the PWI paradigm to study classifier processing in Mandarin native speakers. Participants named pictures with quantifier-classifier phrases (e.g., *yī běn shū*, “one-CL-book”) while ignoring superimposed distractor words. Two factors were manipulated: Classifier Congruency (same or different classifier) and Semantic Relatedness (same or different semantic category). Naming latencies increased with classifier-incongruent or semantically related distractors, showing *classifier congruency* and *semantic interference effects*. EEG data revealed N400-like components for these effects, indicating automatic activation of classifier information during lexical access. Temporal profiles suggest that classifier activation follows semantic processing. Using improved stimuli and advanced statistical methods (e.g., mass univariate permutation test, mixed-effects models), the study suggests that classifiers, similar to grammatical gender, are activated and selected lexico-syntactic features during noun phrase production.

**Chapter 3** employed the BCN paradigm to validate the automatic activation of classifiers observed in the PWI paradigm. Native Mandarin speakers named pictures in homogeneous (items with the same classifiers) or heterogeneous (items with different classifiers) blocks. Naming was faster in homogeneous blocks than in heterogeneous ones, demonstrating a *classifier congruency effect*. ERP data showed more positive waveforms in heterogeneous blocks during the P300 and P600 time windows. The study also investigated the role of visual shape information in classifier processing by manipulating shape similarity within blocks. Naming latencies increased when classifiers shared similar visual shapes (e.g., *tiáo* denoting long-shape objects), revealing a *shape interference effect*. An N400-like component was elicited by shape-dissimilar stimuli, indicating lexical-level processing of visual shape information encoded in classifiers. These findings show that semantic features like visual shapes are activated during classifier processing, in contrast to grammatical gender systems.

**Chapter 4** shifts the focus to second language acquisition. Given the observed differences between classifiers and grammatical gender, we investigated the extent to which late L1-Mandarin learners of German (whose L1 lacks a grammatical gender system) acquire and process German grammatical gender. Two PWI experiments required the participants to produce German determiner-noun phrases (e.g., *der Apfel*, “the apple”). Experiment 1 manipulated Gender Congruency and Semantic Relatedness; Experiment 2 manipulated Gender Congruency and Phonological Relatedness (shared initial phonemes or not). While behavioural data showed no *gender congruency effects*, EEG data revealed gender activation subsequent to semantic processing and phonological encoding. These results align with the *Interpretability Hypothesis*, suggesting that uninterpretable features (e.g., grammatical gender) absent in the L1 are challenging to acquire but can still be activated during production. The dissociation between behavioural and ERP results aligns with the *Missing Surface Inflection Hypothesis*, suggesting these learners acquire grammatical knowledge despite challenges in morphophonological realisation.

**Chapter 5** extends the investigation of lexico-syntactic feature processing from regular to non-canonical nouns, specifically semi-lexical nouns. In German

*pseudo-partitive constructions* (e.g., *eine<sub>FEM</sub> Scheibe<sub>FEM</sub> Käse<sub>MAS</sub>*, “a slice of cheese”), the first noun (e.g., *Scheibe*) functions as a semi-lexical noun. It carries reduced referential content, functions more like a quantificational unit, and governs syntactic agreement for the entire phrase (e.g., the determiner’s gender is determined by *Scheibe<sub>FEM</sub>*, not *Käse<sub>MAS</sub>*). This study examined whether semi-lexical nouns in German pseudo-partitive constructions activate grammatical gender during production in the same way as regular nouns. To address this, a web-based PWI experiment was conducted with native German speakers, manipulating Gender Congruency and distractor Noun Category (regular vs. semi-lexical). The results revealed a significant *gender congruency effect*, which was more pronounced when the distractor was a semi-lexical noun than regular noun. This suggests that semi-lexical nouns not only retain access to lexico-syntactic features but may even enhance it, possibly due to their dual lexical-functional status. Gender activation in semi-lexical nouns may occur through multiple routes: (1) the same lexical pathway as regular nouns; (2) indirect activation via the semantic head noun (e.g., *Käse* in *eine Scheibe Käse*); or (3) through a stored *superlemma* representing the entire pseudo-partitive construction.