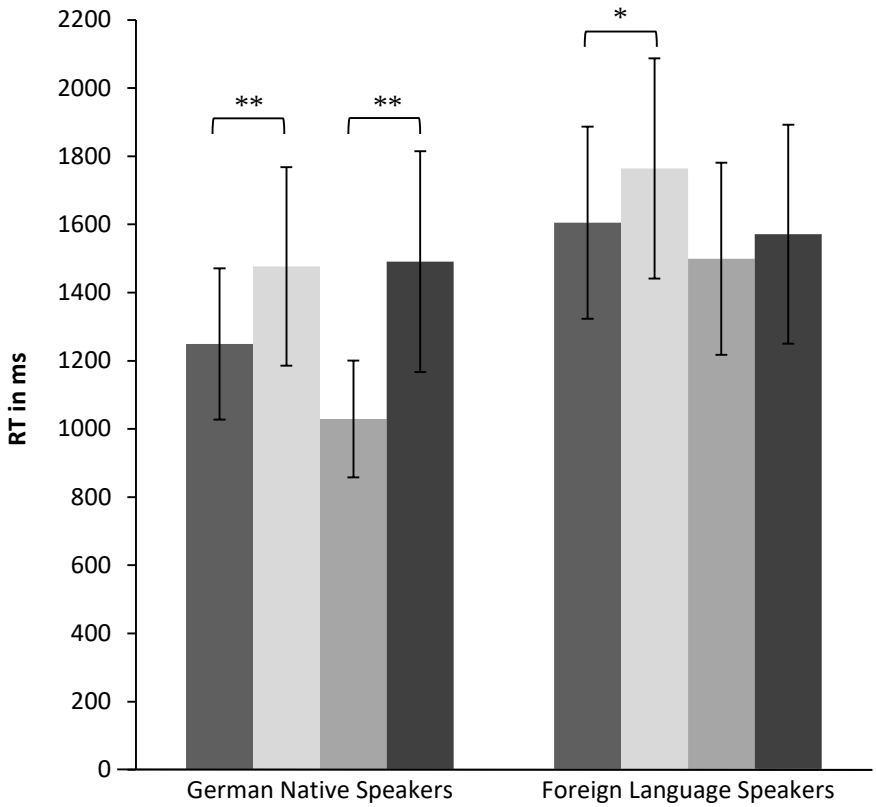
Word and Concept Representation in Late Multilingualism: A Replication and Extension of the Revised Hierarchical Model

One prominent model of the mental lexicon of late bilinguals is the Revised Hierarchical Model (RHM; Kroll & Stewart, 1994), which postulates bidirectional but asymmetrical connections between separate stores for L1 (native language) and L2 (second/foreign language), as well as a shared conceptual store. When L2 is acquired in late bilingualism, a fully developed L1 lexicon with its conceptual store already exists, so the newly learned L2 lexical items are just added to the pre-existing system. Consequently, the connection to the conceptual store is stronger for L1 than for L2, resulting in *translation asymmetry*: During translation from L2 to L1, the direct, lexical connection between the two lexicons is strongest and fastest, bypassing the conceptual store. In contrast, for translation from L1 to L2 the preferred mental route is via the conceptual store, where the activated representation forms the basis for the subsequent search in L2 for a lexical item which describes a corresponding concept. This leads to longer response times and lower accuracy when translating from L1 to L2, compared to L2-L1. Over time, with increasing L2 proficiency, direct links do develop between L2 and the conceptual store (Kroll & Tokowicz, 2005), reducing the asymmetry of the connections (Perani & Abutalebi, 2005; Talamas et al., 1999).

Our study re-examined this hierarchical mental organisation by integrating word and picture processing with naming and translation tasks within one bilingual experiment. Furthermore, it remains unclear whether the RHM also applies to subsequently acquired languages, e.g., L2 and L3. To test this, an identical set of experimental tasks was performed in Experiment 1 by German native speakers with advanced English proficiency (“B2” equivalent; $N = 44$; mean age of acquisition (AoA) = 9.1 years, range: 5-12), and in Experiment 2 by international participants whose (wide variety of different) native languages were neither German (AoA: $M = 16.5$ years, range 7-31) nor English (AoA: $M = 8.2$ years, range 4-15), but who were comparably proficient in both languages (mostly “B2” or “C1 equivalent; $N = 24$). The majority of participants indicated that German was currently the dominant language, presumably because all of them were living in Germany. In order to categorise all participants adequately, we also included a detailed assessment of their proficiency, respective AoA, duration of learning, frequency of usage, language dominance, the number of known languages, and any immersion experiences. Each participant then completed four experimental subtasks: translation English-German, translation German-English, picture naming in German, and picture naming in English. The translation tasks consisted of organised, mixed, and abstract lists of items (see Table 1); the picture naming tasks used semantically organised and mixed lists. These were followed by an unexpected test for any items that participants could recall from the experiment.

As Fig. 1 shows for response times, linear mixed effects models of Exp. 1 largely confirmed the predictions of the RHM: Both accuracies and response times revealed a translation asymmetry. In fact, the effects were even stronger than in the original study (Kroll & Stewart, 1994). Importantly, translation was significantly faster for mixed than for semantically organised lists when translating from L1 to L2, but not from L2 to L1. This suggested that the conceptual store was involved only in translations L1-L2, compared to direct lexical links between L2 and L1. Surprisingly, the multilingual participants in Exp. 2 showed very similar patterns of results to the German native speakers: Despite longer response times and lower accuracies, the same asymmetry was observed in terms of faster and more correct responses when translating from English to German than vice versa (cf. Fig. 1). This suggests that the RHM applies not only to L1 and L2, but also to two foreign languages such as L2 and L3, as long as one of the languages is more prominent in some way. We argue that this prominence can be fostered, among other things, by language salience and the language environment during either initial acquisition or current use (e.g., de Groot and Hoeks, 1995; Beatty-Martinez et al., 2019).

Figure 1: Mean response times in ms for the two different participant samples in Experiments 1 and 2, depending on task. Error bars show standard deviations. ** $p < .001$.



Task	German Native Speakers (Exp. 1)	Foreign Language Speakers (Exp. 2)
Translation ENG - GER	1249	1605
Translation GER - ENG	1477	1764
Picture Naming GER	1029	1499
Picture Naming ENG	1491	1571

References:

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Additional Language Details:
Table 1. Example of one list of items used for translation English-German.

Experimental lists were inspired by those used by Kroll and Stewart (1994), but we adapted their lists in several ways: Among other things, we selected lexical categories and individual items with easy to intermediate translation difficulty and ascertained that every item could be assigned clearly to one semantic category and had a distinct visual representation (except for abstract stimuli). Furthermore, since cognates (i.e. word pairs such as *tomato – Tomate*) might be processed differently from other nouns due to their orthographic similarity (see e.g., Kroll et al., 2002; Sánchez-Casas & García-Albea, 2005), these were avoided in the present study. To ensure that potential effects could be ascribed to the type of list and not to the difficulty of individual items, two parallel experimental versions were created. Words from semantically organised lists in version 1 were used to generate the mixed lists in version 2, and vice versa. For this purpose, the following pairs of semantically organised lists were deemed to be roughly equivalent in difficulty for the two versions: *Vehicles/Buildings, Fruits/Vegetables, Furniture/Kitchenware,* and *Stationery/Clothing*. Four additional lists containing abstract nouns were created for the translation tasks only. The ratio of highly positive or negative words was counterbalanced across these lists. The additional lists used in the experiments were comparable to the following example.

Mixed list		Semantically Organised List (Vehicles)		Abstract List	
English Word Stimulus	*German Response Example*	English Word Stimulus	*German Response Example*	English Word Stimulus	*German Response Example*
mushroom	*Pilz*	car	*Auto*	sadness	*Traurigkeit*
cup	*Tasse*	tram	*Straßenbahn*	fun	*Spaß*
peace	*Frieden*	bicycle	*Fahrrad*	belief	*Glaube*
library	*Bibliothek*	submarine	*U-Boot*	joy	*Freude*
potato	*Kartoffel*	train	*Zug*	fear	*Angst*
trousers	*Hose*	truck	*LKW*	laziness	*Faulheit*
fridge	*Kühlschrank*	cable car	*Seilbahn*	superstition	*Aberglaube*
hospital	*Krankenhaus*	metro	*U-Bahn*	anger	*Ärger*
skirt	*Rock*	plane	*Flugzeug*	wish	*Wunsch*
pain	*Schmerz*	caravan	*Wohnwagen*	adventure	*Abenteuer*