

L2-L1 Word Association in bilinguals: Direct Evidence

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The Revised Hierarchical Model (Kroll and Stewart, 1994) assumes that words in a bilingual's languages have separate word form representations but shared conceptual representations. Two routes lead from an L2 word form to its conceptual representation: the word association route, where concepts are accessed through the corresponding L1 word form, and the concept mediation route, with direct access from L2 to concepts. To investigate word association, we presented proficient late German-Dutch bilinguals with L2 non-cognate word pairs in which the L1 translation of the first word rhymed with the second word (e.g. GRAP (joke) – Witz – FIETS (bike)). If the first word in a pair activated its L1 equivalent, then a phonological priming effect on the second word was expected. Priming was observed in lexical decision but not in semantic decision (living/non-living) on L2 words. In a control group of Dutch native speakers, no priming effect was found. This suggests that proficient bilinguals still make use of their L1 word form lexicon to process L2 in lexical decision.

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Introduction

Bilingualism is becoming a more and more widespread phenomenon. Increasingly it is becoming the norm to be able to speak and comprehend more than one language at least to some extent. There are many questions that are regularly asked by non-experts about bilingualism.

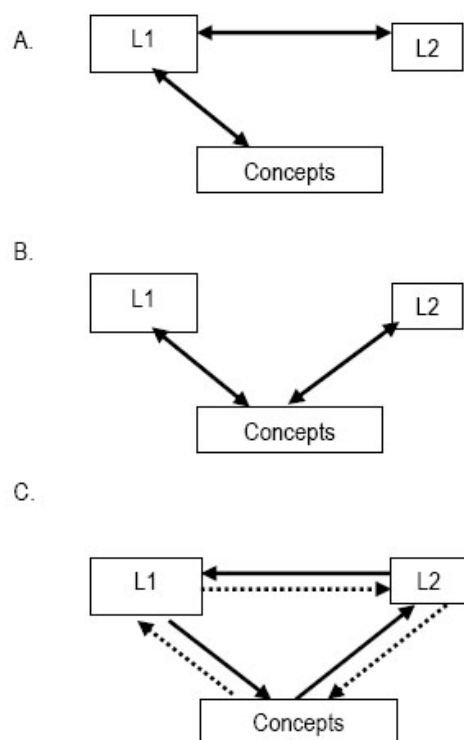


Figure 1. The hierarchical models. A: Word Association Model; B: Concept Mediation Model; C: Revised Hierarchical Model.

Two come to mind: Do bilinguals ‘think’ in different languages depending on which language they are speaking? If they only think in one language, do they ‘translate’ to the other language when using it? This latter question, whether bilinguals automatically translate a word in their second language (L2) to the translation equivalent in their native language (L1) has been incorporated in one class of models of bilingual word representation, the hierarchical models.

Hierarchical models of bilingual processing are models that assume separate lexical (word form level) representations but shared conceptual (meaning level) representations for two translation equivalents in a bilingual’s two languages. Three such models have been proposed so far. The word association model (Potter, So, von Eckardt & Feldman, 1984, see figure 1A) assumes that an L2 word is connected to its corresponding conceptual representation only through its L1 equivalent. Therefore, according to this model if an L2 speaker needs to access the meaning of an L2

word he or she will first activate the corresponding L1 word form and only then access the meaning of the word. The concept mediation model (Potter et al., 1984, figure 1B) proposes that L1 and L2 word forms are both directly connected to their corresponding concept. Access from L2 to L1 word forms occurs through access to the concept.

Potter et al. (1984) compared these two models in a study in which bilinguals performed picture and word naming in L1 and L2, and both L1-L2 (forward) and L2-L1 (backward) translation. The critical predictions for the word association and concept mediation models were as follows: the word association model predicts that L1-L2 translation will be faster than L2 picture naming because picture naming involves concept retrieval, L1 lexical retrieval and L2 lexical retrieval while forward translation only requires L1 lexical retrieval and L2 lexical retrieval. The concept mediation model predicts that both picture naming and forward translation require concept retrieval (either from an L1 word or a picture) and L2 lexical retrieval. The results were in accordance with the concept mediation model, as L2 picture naming was found to be as fast as forward translation. Potter et al. (1984) found this result to be strikingly similar in proficient and less proficient bilinguals. L2 processing was therefore assumed to occur through concept mediation at all levels of proficiency.

Kroll and Curley (1988) challenged the claim that connections between L1 and L2 always occur through concepts. They proposed that a stage in which L1-L2 word form links mediate the processing of L2 words might still exist, but that the non-proficient bilinguals in Potter et al.’s (1984) study might have already passed that stage. In other words, these bilinguals were already too proficient. In an experiment replicating the Potter et al. (1984) study with a wider range of bilinguals, they found that bilinguals who had known their L2 for less than 2 years conformed to the word association model: translation into L2 was faster than picture naming in L2. For more proficient bilinguals the results replicated those of Potter et al. (1984).

Kroll and Curley (1988) also tested another prediction of the concept mediation model: if forward translation occurs through concept mediation then it should be sensitive to semantic factors. They found that L1-L2 translation took longer when words were presented in semantically categorized lists than when the words were presented at random. This result was only true for the more proficient bilinguals, again confirming

the developmental shift from word association to concept mediation.

Kroll and Stewart (1994) posited that translation times from L2 to L1 are faster than vice versa and that this might indicate different processing strategies for the two types of translation. In other words, the lexical and conceptual connections between L1 and L2 might be asymmetric. This idea lies at the basis of the third hierarchical model, the revised hierarchical model (Kroll & Stewart, 1994; figure 1C). Kroll and Stewart (1994) found that the category interference effect occurs for L1-L2 translation but not for L2-L1 translation. This means that concept mediation takes place in L1-L2 translation but not vice versa. The revised hierarchical model (RHM) therefore has two main aspects. First, both lexical and conceptually mediated links between L1 and L2 exist. The lexical link is stronger in the L2-L1 direction than in the L1-L2 direction. The conceptual link on the other hand is stronger in the L1-L2 direction than in the L2-L1 direction. Second, the balance between lexical and conceptual links changes as proficiency increases. The more proficient a bilingual is the more conceptual mediation will occur.

Of the two L2-L1 routes in the RHM, the conceptual route has received the most attention by far. Evidence for this route has been found in quite a number of studies (Dufour & Kroll, 1995; Potter et al., 1984; Zeelenberg & Pecher, 2003). Most studies investigating this route have used some sort of semantic manipulation or semantic task, for example semantic categorization (Dufour & Kroll, 1995; Zeelenberg & Pecher, 2003) or translation of semantically categorized lists (Kroll & Curley, 1988; Kroll & Stewart, 1994). In most of these studies an absence of semantic effects in certain conditions has been taken as evidence for use of the lexical route in these conditions. For instance, L1-L2 translation has been found to be more sensitive to semantic context than L2-L1 translation (Kroll & Stewart, 1994). L2-L1 translation is then assumed to occur through word association because the absence of a semantic effect indicates that it is probably not occurring through conceptual mediation.

One study directly investigating the lexical link was performed by Talamas, Kroll and Dufour (1999). In this study proficient and less proficient English – Spanish bilinguals performed a translation recognition task. The items of interest were the pairs in which the two words were not translation equivalents. There were two types of distractors: if the correct pair was man – hombre, the form related distractor pair would be MAN – HAMBRE (hunger), while the semantic distractor

pair was man – mujer (woman). Less proficient bilinguals made more errors on the form related pairs, while more proficient bilinguals made more semantic errors. This indicates that the less proficient bilinguals were relying more on word form while the more proficient bilinguals were relying more on meaning. However, there are two problems with this study. One is that though all bilinguals were categorized as English-dominant, six participants were in fact native Spanish speakers. This may have clouded the distinction between L1 and L2. Second, the direction of translation was also manipulated: half of the pairs were presented in the forward direction and half in the backward direction. The main conclusions are collapsed across this distinction, but this is a mistake. The RHM would predict more semantic errors in forward translation and more form-related errors in backward translation. In fact, the authors found the opposite pattern.

Another frequently used paradigm has not often been studied in direct relation with word association in the RHM, but may still shed some light on it: masked translation priming. In this paradigm, participants perform a monolingual task (mostly lexical or semantic decision) in either their L1 or L2. Preceding a target word, the translation equivalent of this word is presented as a masked prime. A consistent effect in this paradigm is an asymmetry in the two directions of priming. While an L1-prime presented in an L2 task (L1-L2 priming) produces consistent priming effects (De Groot & Nas, 1991; Gollan, Forster, & Frost 1997; Jiang, 1999; Jiang & Forster, 2001; Kim & Davis, 2003), the reverse direction has mostly led to negative or inconsistent results (Gollan et al., 1997; Grainger & Frenck-Mestre, 1998; Jiang, 1999; Jiang & Forster, 2001; Finkbeiner, Forster, Nicol, & Nakamura, 2004). This is in agreement with the word association route: activating the L1 word when viewing the prime saves time when the subsequent L2 word has to be processed, since activating the L1 word form is a necessary step in processing the L2 word. Since processing the L2 word form is not necessary to perform the task in L1, priming of L1 processing with an L2 prime does not occur. However, one problem with the masked priming paradigm is that it introduces a multilingual element in a purportedly monolingual task. It may be the case that the presentation of primes in another language alters the processing of the target words. The fact that primes are masked does not solve this problem: at some level the primes are being processed, or there would not be a priming effect. Another problem is that it is not clear whether it is the activation of the L1 word form or of the concept that produces the effect.

This means that this priming effect is still not conclusive evidence for the existence of the word association route.

For these reasons, the present study aims at directly investigating the word association route in a completely monolingual task. In this study we investigated proficient German – Dutch bilinguals in a novel paradigm, cross-language mediated phonological priming. For this paradigm L2 word pairs are constructed in which the L1 translation equivalent of the first word rhymes with the second word: GRAP (joke) – Witz (joke) – FIETS (bike). Participants only see the first and third word in the triplet, which are both in L2. The L1 word is never presented, but is assumed to be activated by the participant when performing a task. If this L1 word form is activated, a phonological priming effect on the second L2 word will be observed. This paradigm is similar to the semantically mediated phonological priming paradigm, in which word pairs are used of which a semantic associate of the first word is phonologically similar to the second word, e.g. PEN - ink – INCH (see for an example, Farrar IV, Van Orden & Hamouz, 2001). Since the effect we are targeting is phonological, the presence of a priming effect means that the L1 word form has been activated. This is then very strong evidence that L1 word form plays a role in a monolingual L2 setting. Moreover, we test for this effect in semantic decision (SD) and in lexical decision (LD). This allows us to determine whether L1 involvement in L2 processing is dependent on task demands.

The predictions are as follows: if word association (activation of the corresponding L1 word form) is a necessary step in solving the L2 task, then cross-language mediated phonological priming will be observed. Regarding the two different tasks, the RHM predicts that proficient bilinguals are able to use the concept mediation route. They do therefore not need the word association route to access a word's corresponding concept. A priming effect in SD is not predicted by the RHM, but would indicate that even proficient bilinguals use the word association route. For LD no clear predictions concerning cross-language mediated phonological priming are made. It has not been clearly specified which processing steps a bilingual person takes to perform LD in L2. If access to concepts is necessary, then results should be similar to those found in SD. If the L1 word form is accessed to perform the task, then the cross-language mediated phonological priming effect will be found.

Method

Participants

25 Germans (6 male) participated in this experiment. They were students in Nijmegen and followed university education in Dutch, which meant they were relatively proficient in Dutch. All learned Dutch after puberty. L2 proficiency was assessed with a short standardized proficiency test. The test consisted of a text in which 60 words of different categories had to be filled in in gaps in the text. The Germans scored an average of 53 out of 60, with a standard deviation of 5. This is at the lower end of the normal range for native Dutch speakers, which is 53 to 60 out of 60. 26 (8 male) Dutch native speakers, also students, participated as a control group.

Stimuli

34 word pairs were constructed, in which the German translation of the first word rhymed with the second Dutch word. Examples are: GRAP (joke) – Witz – FIETS (bike); ROOSTER (schedule) – Stundenplan – KRAAN (tap). All primes in these pairs were clear non-cognates with their translation equivalent in German, while for the targets an effort was made to keep phonological similarity as low as possible. Control pairs were constructed by shuffling primes and targets (GRAP – KRAAN, ROOSTER – FIETS). All words in experimental pairs were pilot-tested with a group of three beginning learners of Dutch, to test whether the words would be known to the participants. 14 of the German participants in the experiment were also asked to translate the words on a later date. 68 filler pairs were added, which mostly consisted of cognates. This was done because most Dutch and German words are cognates. An experiment with only non-cognates would therefore be odd and this might be noticed by the participants. For lexical decision another 136 pairs containing either one or two nonwords were presented as well. These were constructed by changing 1 – 3 letters in the Dutch filler words. All nonwords were orthographically legal in Dutch.

Design

There were two tasks in this experiment: lexical decision (LD) and semantic decision (SD; living/non living). The lexical decision was always presented first to avoid semantic carry-over effects from the semantic decision. This had the disadvantage that since the same items were presented in the two tasks, repetition priming effects may have occurred in SCT. However, the requirements on the items strongly limited the number of possible items, which made it

		Related RT (ms)	Error(%)	Unrelated RT (ms)	Error(%)	Priming (ms)
LD	Dutch	582	6.73	588	5.36	6
	German	708	4.57	736	4.43	28
SD	Dutch	711	9.75	725	12.36	14
	German	789	10.42	805	11.90	16

Table 1: RTs and error rates per task, condition and group

		Related RT (ms)	Unrelated RT (ms)	Priming (ms)
LD	L1	582	588	6
	L2-long	649	656	7
	L2-short	708	736	28
SD	L1	711	725	14
	L2-long	749	753	4
	L2-short	789	805	16

Table 2: RTs per group, task and condition with L2 group split according to length of stay in the Netherlands.

impossible to split items across the tasks. Both tasks were carried out in Dutch, which was L2 for the Germans and L1 for the Dutch. All experimental pairs were presented both in lexical decision and semantic decision.

Participants had to perform the task (either LD or SD) for both items in a pair. This was done because the question of interest is whether processing the first L2 word activates the L1 word form, which then produces the targeted priming effect on the second word. Also, the question was whether task demands would influence the activation of the L1 word form. Therefore, the task had to be processed on the same item of which L1 word form activation was assessed, namely the prime.

Procedure

Participants sat in a soundproof lab with a PC screen and a button box. Responses were given using the index and middle finger of their preferred hand. For each task, instructions were first shown on screen. After that a practice block started, which consisted of a maximum of 6 blocks of 10 item pairs. During practice participants got feedback on both speed and accuracy after every pair. Practice ended when answers to all 6 words in the last 3 pairs in a block were correct and with an RT under 1000 ms. This was done to train participants in being both fast and accurate. After practice the experiment started, in which no feedback was given. Words were presented in pairs, meaning that the second word of a pair was presented as soon as an answer was given to the first word, with an ISI of 20 ms during which a hash mark mask was presented, while there was a

500 ISI between pairs, in which a fixation cross was presented. Each word remained on screen until a response was given. Pauses were given during the experiment.

Results

The RTs for each condition, group and prime type are shown in table 1. All incorrect answers and RTs more than 3 standard deviations from the group/task mean were removed. One subject was also removed from the SD data because she pressed the same button on 90% of the trials, indicating that she was not really performing the task. Based on the translation posttest performed by 14 of the German subjects, all items that were not known or given a different translation than our target by 3 or more of the participants, were removed. These items were 3 primes and 3 targets. All pairs containing one of these words were removed from the data. One subject was also removed from the data because she did not know half of the items in the posttest. Data was analyzed separately for each task in a 2x2 (group x priming) repeated measures GLM. Data was only analyzed by subjects since due to the specific requirements for the item pairs, generalization across many items is not a practical possibility. For LD significant main effects were found for group ($F_s(1,49) = 31.182, p < 0.000$) and pair type ($F_s(1,49) = 9.807, p < .003$). The effect of priming was qualified by an interaction between group and priming ($F_s(1,49) = 4.159, p < 0.047$). Planned comparisons for the effect of pair type within the two groups revealed that the effect of

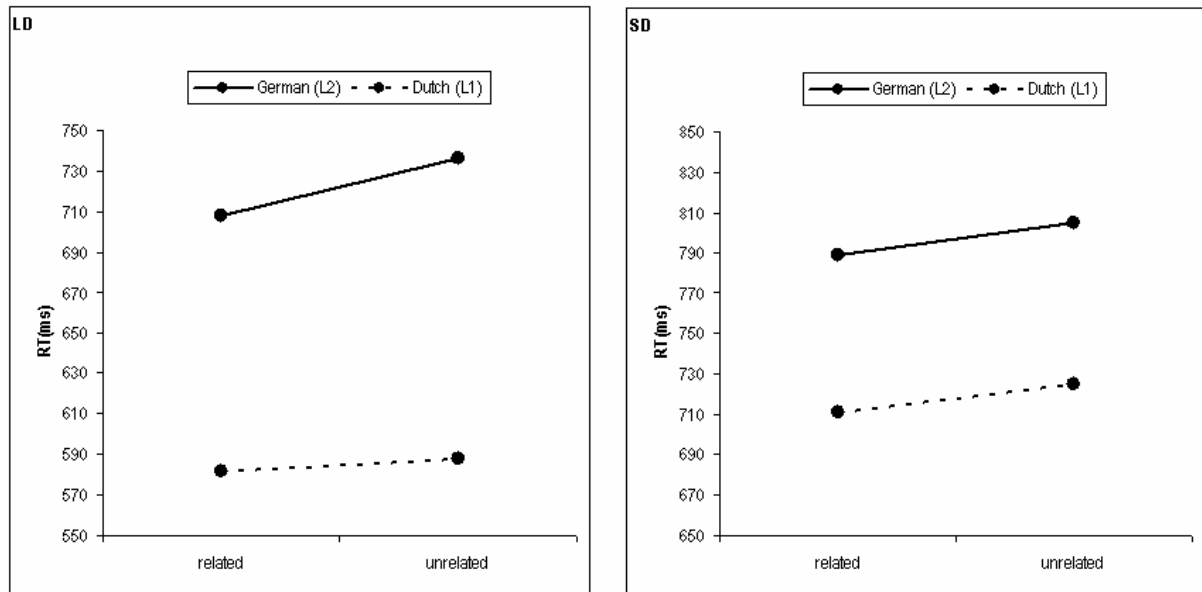


Figure 2: Interaction plots for group and priming

pair type was only significant for the Germans ($F_{s-L2}(1,49)=13.113, p=0.001; F_{s-L1}(1,49)<1$), In SD only a main effect of group was found ($F_s(1,49) = 8.015, p<0.007$). The effect of pair type was marginal ($F_s(1,49) = 3.965 p<0.052$) and there was no interaction between group and priming. Planned comparisons revealed that the effect of priming was significant in neither group (L2: $F_s(1,49)=2.152, p<.149$; L1: $F_s(1,49)=1.817, p<.184$). Interaction plots for this effect are shown in figure 2.

In sum, these results show that, as expected, word form association only takes place in the Germans. Moreover, it only takes place in lexical decision, not semantic decision. These results indicate that proficient bilinguals can use the word association route. The RHM model predicts that use of the

word association route decreases as bilinguals become more proficient. To test this prediction, we split our bilinguals based on the time they had known Dutch. The shorter stay group had been in the Netherlands for an average of 8.5 months (range 5 to 18, SD = 4.6. the longer stay group had a mean stay of 51.5 months (range 18-120, SD = 30.4).

In this 3x2 (group x priming) repeated measures GLM, the following effects were found for LD: priming had a main effect ($F_s(1,48) = 13.895, p<.001$), which was qualified by an interaction between priming and group ($F_s(2,48) = 6.159, p<.004$). Group also had a significant main effect ($F_s(2,48) = 31.786, p<.000$). Planned comparisons revealed that the effect of priming was only significant for the group that had been in the

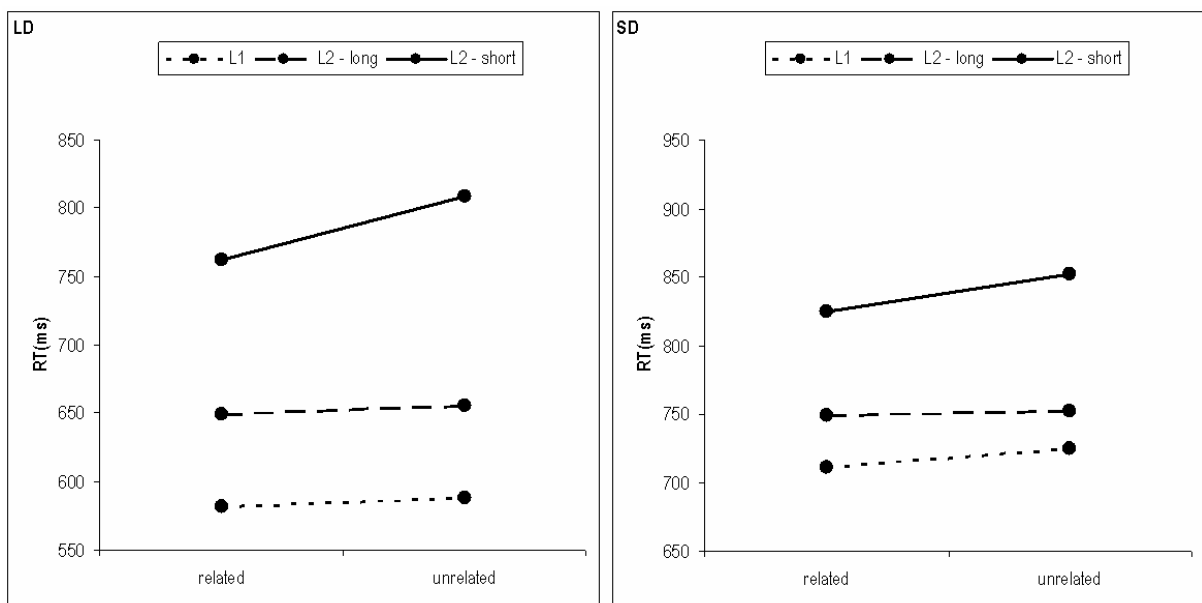


Figure 3: Interaction plots for group and priming. L2 speakers are split in two groups: shorter stay and longer stay.

Netherlands for a shorter time (shorter stay: $F_s(1,48) = 22.007$, $p < .000$; longer stay and L1-speakers: $F_s(1,48) < 1$). In SD only the effect of group was significant ($F_s(1,48) = 6.997$, $p < .002$). The main effect of priming was marginal ($F_s(1,48) = 3.512$, $p < .067$). Planned comparisons revealed that the effect of priming was marginal in the shorter stay group but non-significant in the longer stay group (shorter stay: $F_s(1,48) = 3.413$, $p < .071$; longer stay: $F_s(1,48) < 1$; L1-speakers: $F_s(1,48) = 1.828$, $p < .183$).

Discussion

In this experiment we investigated evidence for word form association from L2 to L1 in lexical decision and semantic decision. We found evidence for cross-language mediated phonological priming (GRAP – Witz – FIETS) in lexical decision but not in semantic decision. As predicted, the effect was found in the German subjects (L2 speakers) but not the Dutch subjects (L1 speakers). This result is as far as we know the most direct evidence for the existence of the word association route in L2 processing. So far, most studies investigating this issue have introduced primes of one language while the participants were doing a task in the other language. Presenting materials from another language may very well affect the very processes that are under investigation. In this study we presented no L1 materials and therefore obtained strong evidence that when participants are performing a completely monolingual task in their L2, they still make use of their L1. Also, other studies have not been able to fully distinguish form and concept priming effects: L1-L2 translation priming effects can either be due to the shared activation of the L1 word form or of the concept. Since in this study we targeted a phonological effect, the priming effect we find can only be due to L1 word form activation.

The fact that this result is dependent on the type of task participants are performing is also important. So far, most of the studies aiming at the conceptual link have used conceptual tasks or conceptual manipulations (Dufour & Kroll, 1995; Kroll & Stewart, 1994; Zeelenberg & Pecher, 2003), while studies aiming at the lexical link have mostly made use of lexical decision tasks with cross-linguistic primes (De Groot & Nas, 1991; Gollan et al., 1997; Jiang, 1999; Jiang & Forster, 2001; Kim & Davis, 2003). It might therefore also be that the different results these studies have obtained are partly due to the fact that different tasks were used. In the present study we have targeted the word association link but have used both a semantic task and a less semantic task to do

so. In the present study, the cross language mediated phonological priming effect appears to be present only in lexical decision, indicating that the lexical route is used in lexical decision but not (or less so) in semantic decision. One drawback is that our semantic task may have suffered from repetition priming effects, since the same items were presented in lexical decision first. Due to the limited number of items they could not be split across the two tasks. We decided that it was more crucial to keep the difference between the semantic and non-semantic task as large as possible by avoiding semantic carry-over effects in the LD. It was also important to do both tasks in the same group of subjects. Since the target population is very heterogeneous in terms of age, age of acquisition, proficiency and use of L2, any differences arising between groups are difficult to interpret.

The finding that lexical mediation is task-dependent within the same group of bilinguals, sheds a new light on the distinction between conceptual links and lexical links. So far, most authors have assumed that the conceptual link is more ‘advanced’ than the lexical link. L2 learners therefore start out using the lexical link but once they are able to conceptually mediate L2 words, they will mostly always do so. Our data on the other hand suggests that even when L2 learners are able to conceptually mediate, they might only do so when this is necessary, i.e. when they have to access the concept. When the concept is needed to solve the task at hand, the most efficient route from the L2 word to the concept is the conceptual link. When access to the conceptual level is not necessary, apparently participants make use of the lexical link and solve the task by accessing the L1 word form.

However, the separate analysis of the two groups of German participants reveals that a developmental pattern does indeed occur. In the group of Germans that had spoken Dutch for a longer time no cross-language mediated phonological priming effect was found, while in the group that had spoken Dutch for a shorter time the effect was strong. Therefore, the more proficient the speaker is in his or her L2, the less he or she makes use of the lexical link. This is exactly what the RHM predicts. It is worth stressing however that all our bilinguals were highly proficient. This was due to a number of factors: first, German and Dutch are very much alike, which facilitates rapid acquisition of Dutch. Second, the participants in our experiment were all taking higher education in Dutch, therefore using Dutch on a daily basis and at a high level.

In conclusion, the current studies provides convincing evidence for the existence of the lexical route in a purely L2 context. In some cases, bilinguals therefore do translate L2 words to L1 words when processing them. As predicted by the RHM, this happens less as proficiency increases. However, the present results show that lexical mediation is dependent on task demands. The same bilinguals appear to use the direct conceptual route when doing SD and the lexical route when doing LD. Further research will be necessary to investigate what task demands influence the use of the lexical link. This is important because neither lexical decision nor semantic decision are very natural tasks. It therefore remains to be seen how much L1 word form access is likely to happen in an everyday context.

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