ABSTRACT

Language Proficiency's Role in Backward Priming Effects

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Some inconsistency is found in past literature on backward priming effects on the basis of proficiency in an L2. Simultaneous bilinguals generally display strong backward priming effects, but sequential bilinguals may not. To determine if and when it is possible for sequential bilinguals to display backward priming effects, students of varying L2 proficiencies in German (beginner and intermediate speakers) and highly proficient professors (advanced speakers) were investigated using a generalized LDT with cognate, noncognate, and unrelated primes. Ultimately, it was found that the advanced group differed from the intermediate and beginner in terms of total priming effect sizes, but with smaller effect sizes than the less proficient groups. Additionally, cognate and noncognate priming effect sizes did not differ from each other. These findings are inconsistent with past literature, and a number of limitations and recommendations for future studies are given.

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LANGUAGE PROFICIENCY'S ROLE IN BACKWARD PRIMING EFFECTS

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Dedicated to my mother and father, who know me better than I did myself

and never let me give up

CHAPTER ONE

Introduction

Fluency in a second language (L2) is the ultimate goal of many collegiate learners of foreign languages, and this goal necessarily entails a high degree of proficiency in the target L2. But what constitutes proficiency? Kroll, Tokowicz, and Dufour (2002) found that performance on simple L2 picture naming and translation tasks increases with proficiency in an L2, but it is unclear as to what cognitive mechanism underlies this increase. Additionally, Kroll et al.'s study demonstrated that translation from the L2 to the first language (L1) was faster than translation from the L1 to the L2 in both language learners and bilinguals, although the effect in the bilingual group was not as pronounced as in the language learner group. These results, although initially somewhat surprising, fit well within the framework of the bilingual interactive activation model (BIA+) (Dijkstra & van Heuven, 2002; van Heuven, Dijkstra, & Grainger, 1998).

The BIA+ model assumes an integrated lexicon for language, meaning that all of the words one knows, regardless of their language of origin, are grouped together in one's mind (Dijkstra & van Heuven, 2002). However, the lexicon stores information regarding which word belongs to which language, such that the brain may inhibit or activate words based on the activation of so-called language nodes. This inhibition and activation effect offers an explanation for the findings observed in Kroll et al.'s (2002) study above, in that as languages compete in the mind of a speaker, varying levels of activation and inhibition will be experienced. Moreover, the BIA+ operationalizes proficiency in a

language as the relative strength of the activation-inhibition network associated with a language node and its constituent lexical items. Operationalizing proficiency in this way would explain the contrast observed in Kroll et al. between L2 learners and fluent bilinguals: the bilinguals' language systems are fully developed such that their inhibition-activation networks are of similar strength, and therefore the magnitude of difference between L1 and L2 translation tasks is less for bilinguals than for L2 learners with networks of varying strength.

This activation-inhibition system is reminiscent of Collins and Loftus' (1975) spreading-activation theory of semantic processing, and, indeed, the old BIA model was updated in the form of the BIA+ model so as to incorporate semantic nodes within its framework. The BIA+ model integrates the lexicon, language nodes, orthographic characteristic nodes, semantic nodes, and phonological characteristic nodes in an interconnected system of inhibition and activation, such that all the myriad components of a word are entered in the brain's analysis of that word.

Importantly, this activation-inhibition system may be used to explain backward priming effects observed in polylinguals, where backward effects describe priming from L2 to L1 rather than the conventional forward priming of L1 to L2. Backward priming effects in a lexical decision task (LDT) were first reported by Koriat (1981) and describe the effects of priming from a target to a prime, which is the reverse of the traditional conception, i.e. prime to target. However, doubt surrounds the explanatory power of the spreading activation model in regard to backward priming effects. Research by Chwilla, Hagoort, & Brown, (1998), for example, suggests post-lexical mechanisms for backward priming effects rather than pre-lexical semantic activation. Post-lexical mechanisms

mean that a word must be recognized before activation of associated words may begin rather than a word's concept being automatically activated and spreading to other words before conscious recognition of the first word has occurred. The BIA+ model sidesteps this issue by postulating both pre- and post-lexical phonological and orthographic processes. Moreover, due to the nature of bilingualism itself, there is no spreading activation from one semantic concept to another in translation, but from only one concept to two lexical forms, i.e. the L1 representation and the L2 representation of a given semantic concept.

L2 semantic priming is evidenced by cognate facilitation effects, such as those observed in one of the first investigations into backward L2 priming by de Groot, Dannenburg, and van Hell (1994) who found significant differences in the time required for participants to translate a word with respect to that word's meaning both forwards and backwards. Additional support comes from a study by Poarch and van Hell (2012) who found significant differences between the time it took subjects to identify a picture using an L2 cognate as opposed to an L2 noncognate. Importantly, Poarch and van Hell also noted a significant backward cognate facilitation effect, but only for those polylinguals in their study who were more balanced and, therefore, highly proficient.

The question arises, therefore, as to what role proficiency plays in forward and backward priming. The preceding studies suggest that a high level of proficiency is necessary for backward priming effects to occur, but a study comparing Hebrew and English bilinguals of relatively high proficiency levels found no backward priming effect (Gollan, Forster, & Frost, 1997). This lack of backward priming effects, again, contrasts with past literature suggesting that it is low proficiency bilinguals, and not highly

proficient bilinguals, who fail to demonstrate a backward priming effect, as shown by Dimitropoulou, Duñabeitia, and Carreiras (2011). However, the participants used in Gollan et al. and Dimitropoulou et al.'s studies actually have similar language histories in that both populations are late bilinguals, i.e. individuals who have begun acquiring their L2 after puberty. A masked LDT performed using highly proficient, simultaneous bilinguals, i.e. bilinguals who acquired their L2 alongside their L1 from well before puberty, found significant forwards and backward priming effects, as would be expected of such a population (Duñabeitia, Perea, & Carreiras, 2010).

Therefore, it may be that one's proficiency level in an L2 is not the critical factor motivating backward priming effects at all, but rather one's age of L2 acquisition. The true relationship between these factors, however, is unclear in the literature surrounding this issue at present, and, moreover, the BIA+ does not predict what sort of proficiency would be necessary for backward priming effects to be demonstrated. Therefore, additional research is necessary to resolve the issue of whether late bilinguals are ever capable of demonstrating strong backward priming effects. Unto this end, the present study investigates college-aged student L2 German learners from several semesters of study so as to determine at what point in a learner's L2 career backward priming effects may be observed. Additionally, both extremely proficient and native speakers of German, e.g. professors of German, will be investigated so as to investigate whether backward priming effects may ever be achieved, even after many years of study. This investigation is enacted using both forwards and backward masked priming in the form of a generalized LDT. Based upon the previous research in this area, asymmetrical priming effects are predicted, such that the low proficiency student learners will demonstrate

forward priming effects, but not backward priming effects, and that only the most advanced of the speakers, i.e. the native speakers and professors of German, will demonstrate meaningful backward priming effects.

CHAPTER TWO

Method

Participants

Participants included twenty-four individuals recruited from the German language department at Baylor University. The subject pool included students from various semesters of study, ranging from GER 1401 (the first semester of German) to GER 2320 (the fourth semester, which represents the completion of the university requirement of four semesters of foreign language study), as well as a variety of GER courses enrolled in after completion of GER 2320, with the remainder of the subjects being German language professors. Participants were recruited through face-to-face interactions on campus and through flyers posted around campus and handed out to the German professors for distribution amongst the students. Participation in the study was compensated with cookies, as well as extra credit, at the discretion of the professor whose course a student was enrolled in.

Materials

The stimuli to be used in this study were prepared by the researcher and include four separate word-pair conditions: cognate, noncognate, unrelated, and false. Each condition consists of a forward and backward prime set, such that the cognate condition has separate lists for cognate English prime words with German targets (forward) and cognate German prime words with English targets (backward), e.g. "cat" to "*Katze*," and "*Maus*" to "mouse" respectively; the noncognate condition has separate lists for

noncognate English primes with German targets and noncognate German primes with English targets, e.g. "pants" to "*Hosen*," and "*Vogel*" to "bird" respectively; the same is true of the unrelated condition, although these words do not share meanings, e.g. "walrus" to "*Klavier,*" ('piano') and "*schwer*" ('difficult') to "blue"; finally, the false condition consists of distractors composed of English and German words with a single letter missing from them, and these are primed with another random distractor of the nontarget language, e.g. "grden," to "*Gefhr*," (meant to be 'garden' and '*Gefahr,'* meaning 'risk') and, "*strk*," to "vsion" (meant to be '*stark*,' meaning 'strong' and 'vision').

The LDT performed by the subjects was run on E-Prime software and was adapted from a previous reaction-time based task (Schneider, Eschmann, & Zuccolotto, 2002).

Design

Subjects gave a self-report estimate of their proficiency in German at the start of the testing session in lieu of an objective measure; past research indicates the validity of self-report proficiency measures (Rosenthal, Wang, Schillinger, Perez Stable, Fernandez, 2011). Participants then underwent the LDT using the E-Prime software installed on a laptop provided by Dr. Dracos of the linguistics department. Participants sat in front of the computer running the LDT off the E-Prime software and were instructed to focus on the screen. A series of instructions was presented to the subjects when they began the task, explaining that they would be asked to choose between legitimate and illegitimate German and English words, and to indicate real words by pressing the 'M' key, or false words by pressing the 'Z' key. Furthermore, participants were asked to perform this task

as quickly, yet as accurately as possible. Subjects were given eight practice trails which were not scored before the task began in proper. Both the practice and experimental trails followed the same procedure. First, a fixation point ("+") was presented to the subjects at the center of the screen for 500 ms. This was followed by a forward mask of five hash tags ("#####") for 500 ms. Then the prime was displayed in lowercase letters ("cat") for 47 ms, followed by a back mask of another five hash tags ("#####") for 453 ms. Finally, the target word appeared ("*KATZE*") for 2500 ms, or until the subject pressed either 'Z' or 'M'. If the subject did not press either key, the next trail began automatically after the 2500 ms timer ran out. Subjects completed 180 experimental trials, requiring approximately 15 minutes. Measurements were taken from the length of time it took participants to make a decision regarding target legitimacy, starting with the presentation of the target following the mask and prime. Upon completion, the researcher inquired as to whether the subject "noticed anything about the experiment." This and subsequent questions were meant to probe for subject awareness of the prime words used in the experiment. The subjects were then free to leave the experimental area and take a cookie or two.

CHAPTER THREE

Results

Twenty-four participants were recruited in total, but four were excluded from the final analyses: two due to equipment malfunction, resulting in a loss of the participants' data; and two due to their status as native German speakers who were in the process of learning English. These twenty participants were divided into three groups for the purposes of analysis depending on the amount of time they had studied German. The first group (n = 7) consisted of beginning students of German who had not completed more than four semesters (or the equivalent) of study at Baylor, the second group (n = 6) consisted of intermediate students of German who had completed five or more semesters (or the equivalent) of study at Baylor, and the third group (n = 7) consisted of professors of German at Baylor who were both L1 German L2 English speakers (n = 3) and L1 English L2 German speakers (n = 4). Including all the professors in a single group was predicated upon a factorial analyses of variance (ANOVA) conducted on the mean reaction times (RT) of these speakers which revealed no statistically significant differences between native and nonnative speakers' prime effect sizes ($F_{(1, 20)} = 1.382$, $p = 0.254$). All participants were at least eighteen years of age at the time of their participation

Self-report estimates on a one to ten scale of the participants' proficiency in reading, writing, and speaking German were collected at the time of testing. The mean scores of these estimates indicate that the participants' division into beginner,

intermediate, and advanced groups were legitimately made, because their scores were differentiated along these lines. The beginner group reported an average of 5.14, 4.86, and 3.29 for their proficiencies in reading, writing, speaking, respectively. The intermediate group reported an average of 6.50, 6.67, and 6.67 for their proficiencies in reading, writing, speaking, respectively. Finally, the advanced group reported an average of 9.43, 9.29, and 9.00 for their proficiencies in reading, writing, speaking, respectively. Additionally, the manipulation check which required participants to indicate whether or not they were aware of the primes used in the study indicated that every participant was aware of the primes used during the course of the study.

These groups' mean RT to the LDT stimuli described above were analyzed using a factorial ANOVA. RT above one second were excluded from analysis (19.83% of total data), as RT above this limit likely represent a departure from autonomous priming effects and are likely the result of conscious participant deliberation. Additionally, responses from the distractor condition and inaccurate responses (6.89% of data) were omitted from analysis, as the primary concern of this analysis is on the differences in participant groups' RT due to the cognate conditions and the differences in their priming effects, rather than participants' ability to discriminate between correctly and incorrectly spelled English or German words. Participant groups differed significantly in their mean RT ($F_{(2, 1468)} = 108.213$, $p < 0.001$). Post-hoc testing with Scheffé's method revealed that all three groups differed significantly from one another: the beginner group from the intermediate group (M = 60.44, $p < 0.001$), the beginner group from the advanced group (M = 68.06, $p < 0.001$), and the intermediate group from the advanced group (M = 128.51, $p < 0.001$). Participant groups' RT differed significantly depending on what

language they were primed with ($F_{(1, 1468)} = 8.279$, $p = 0.004$). Participant groups' RT also differed significantly depending on whether they were primed with a cognate, noncognate, or unrelated word relative to the target ($F_{(2, 1468)} = 22.370$, $p < 0.001$). Post-hoc testing with Scheffé's method revealed that RT did not significantly differ between the cognate and noncognate prime conditions (M = 4.23, $p = 0.889$), but that RT did differ between both the cognate and unrelated conditions (M = 52.78, $p < 0.001$) and the noncognate and unrelated conditions (M = 48.55, $p < 0.001$). There was also an interaction between the groups of speakers and the cognate condition of the prime ($F_{(4, 1468)} = 5.827$, $p < 0.001$).

Another factorial ANOVA was performed to evaluate the mean priming effects of the various cognate conditions on the groups' RT (which are reported below in Figure 1). Participant groups' RT differed significantly between participant groups ($F_{(2, 66)} = 13.207$, $p < 0.001$). Post-hoc testing with Scheffé's method revealed that the advanced group significantly differed from the both the beginner group (M = 57.614, $p = 0.002$) and the intermediate group (M = 76.718, $p < 0.001$), but that the beginner group did not significantly differ from the intermediate group (M = 19.104, $p = 0.494$). Participant groups' RT did not differ significantly between the various cognate priming conditions, however ($F_{(3, 66)} = 0.536$, $p = 0.660$).

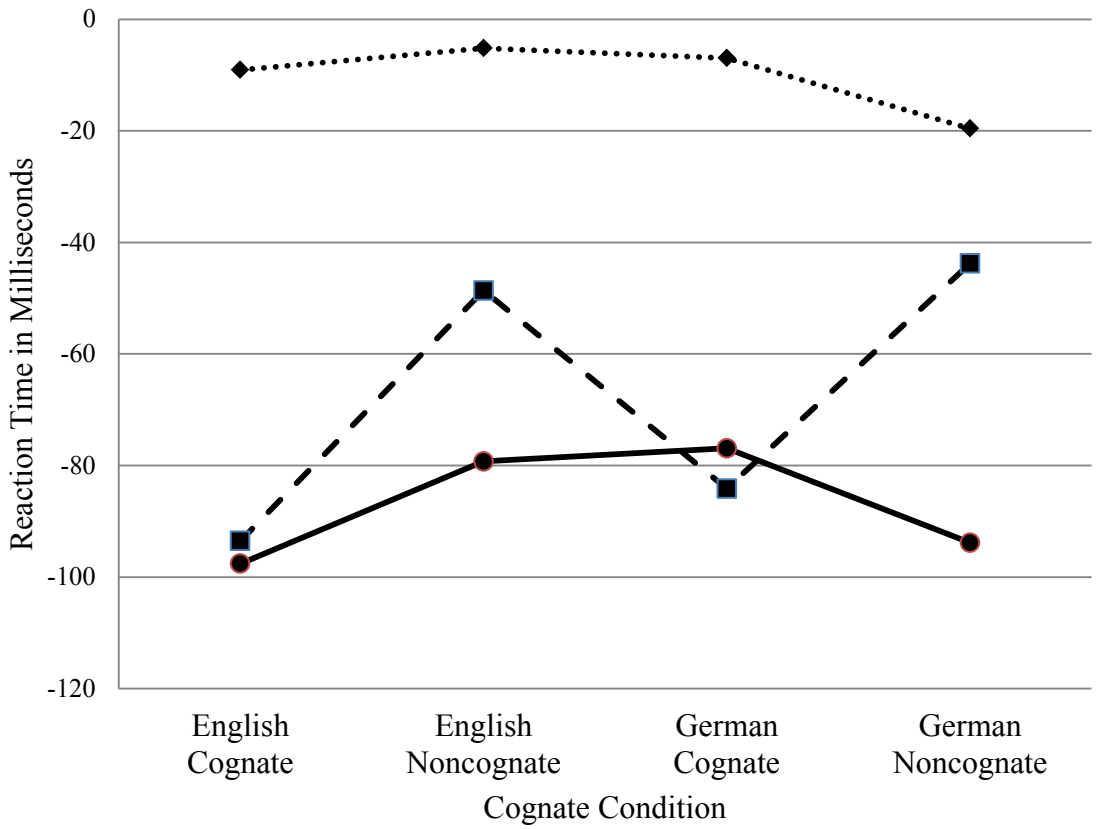

Figure 1. The mean prime effects, i.e. the reduction in RT due to a prime as compared to unrelated word, on groups' RT by cognate condition.

CHAPTER FOUR

Discussion

The present study investigated whether backward priming effects might ever be observed over the course of a late language learner's L2 career with a sample of undergraduate students and professors of German at Baylor University. It was hypothesized that low proficiency participants would display asymmetrical priming effects, and that only the most advanced speakers would display robust backward priming effects, but due to a lack of statistical significance between the priming conditions across all participant groups these hypotheses were not supported. Advanced speakers did significantly differ from the less proficient speakers, but not in the expected fashion – advanced speakers displayed much less priming than any of the other speakers, and with very little variation between cognate priming and noncognate priming. Beginner and intermediate speakers, however, displayed robust cognate and noncognate priming effects in both English and German, although the two groups did not significantly differ from each other. Finally, the priming effects observed in all participant groups did not significantly differ between the cognate conditions or across languages.

These results oppose prior research on priming effects in bilinguals: high proficiency bilinguals display greater priming effects than less proficient bilinguals and low proficiency bilinguals do not display similar forward and backward priming effects (Kroll, Tokowicz, & Dufour, 2002; Dimitropoulou, Duñabeitia, & Carreiras, 2011). Indeed, a lack of difference in priming effect across languages is only expected in highly

proficient, simultaneous bilinguals, but not in a population of late, low proficiency bilinguals as seen here (Duñabeitia, Perea, & Carreiras, 2010). The lack of a difference across language conditions in the advanced speaker group in the present study suggests that the advanced speaker group has a conventional backward priming effect, i.e. both languages demonstrate similar priming effects. However, the lack of differentiation in this group between cognate and noncognate effects and the relatively low prime effect sizes in this group suggest that this result is in fact insignificant as well.

Several limitations of the present study may account for the inconsistencies observed between the findings of the present study and that of prior research. For instance, the stimuli used in the LDT, i.e. the prime and target words, were assembled by the researcher and have not previously been established as reliable or valid by prior research. Additionally, a limited number of participants were recruited for this study, and the recruitment method used did not allow for random selection. Because random selection was not utilized in recruiting participants, it is therefore unlikely that individual variation and differences between the participants were spread evenly across the groups, which reduced the statistical power of the results obtained from them. Finally, the administration of the LDT itself may have influenced the results. Most student participants completed the task approximately seven to ten feet away from the researcher, but the professors were often tested in close proximity to the researcher, i.e. less than five feet. As a result, the student participants had to disengage from the task and locate the researcher before they could ask questions or make comments. The professors, however, were able to remain engaged with the LDT and simultaneously question or offer comments to the researcher. In practice, student participants generally waited until the

end of the LDT to ask questions, while professors routinely engaged in commentary during the administration of the LDT. This lack of focused attention by the professors could account for some of their variance from the predicted results.

The results of the study may also have been influenced by differences between the participants other than proficiency in German. For example, all of the participants constituting the advanced speaker group were over the age of thirty-five, and age is associated not only with a decline in RT, but also with an increase in the variability of responses in RT-based tasks (Hultsch, MacDonald, & Dixon, 2002). Therefore, the relatively low RT and priming effects obtained from the advanced group could be due to increased age-related response latency, increased variability in response times, or a combination thereof. Alternatively, the student participants may have had more practice participating in RT-based tasks, and the task format was therefore more familiar and comfortable to them. The professors may have had less practice with such RT tasks, and could have had more trouble aligning their behavior to the task at hand.

Future research investigating backward priming effects should concentrate primarily on recruiting a larger sample of participants with a randomized selection process. A randomly selected sample of a larger size will be more likely to have more homogenous groups, and therefore greater power in determining the significance of the differences between participant groups. Future investigators at Baylor University are advised to target language departments with larger student and professor populations unto this end, such as the Spanish or French departments. Decreasing the variability of LDT administration practices across participant groups would also be helpful in reducing the variability of the data gathered from the participants.

In sum, no difference was found between the priming effects of cognates and noncognates on the RT of speakers performing a generalized LDT at any level of proficiency in German, nor between the priming effects of English (the L1 for most participants) or German (the L2 for most participants). A lack of differentiation between the priming effects of the two languages in the high proficiency group is suggestive of conventional backward priming effects, but the size of the effects and the similarity of the cognate and noncognate conditions calls even this result into question. A significant difference was found between the low proficiency groups and the high proficiency group, but the low proficiency groups actually experienced greater prime effects than did the high proficiency group. These results are counter to the literature surrounding the issue of backward priming at present, and leave the hypotheses of this study unproven. The reasons for this inconsistency are numerous, and relate both to the nature of the task itself, such as the stimuli used, the number of participants recruited and the nature of their recruitment, and the administration of the LDT, as well as characteristics of the participants themselves, such as differences in age and task familiarity. Therefore, because this study found no discernable differences between beginning students of German and intermediate students who had been studying the language for several years, additional research is necessary to more thoroughly investigate the issue of whether backward priming effects can be demonstrated in late bilinguals, and if so, at what point in the study of an L2.

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