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How Phonological and Syntactic Overlap Impact Cognate Processing Speeds in Bilinguals

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Abstract

Background: This paper investigates individuals who are proficient in two languages (bilinguals) and the speeds at which bilinguals process cognates (words with comparable form and meaning across languages). This paper cites two ongoing experiments: The Language Identification (LID) task and the Self-Paced Listening (SPL) task.

Aims: The LID aims to assess how bilinguals process cognates in isolation based upon either their high levels of phonological (sound) or syntactic (grammatical) overlap. The SPL aims to assess how bilinguals process the same cognates from the LID in sentence contexts, rather than in isolation. Overall, these tasks aim to examine whether phonological and syntactic overlap have distinct and measurable impacts on language processing speeds in bilinguals. In addition, these tasks aim to assess whether placing cognates in sentences has a measurable impact on processing speeds.

Main Contribution: Findings from the LID task suggest that phonological overlap in cognates facilitates bilingual language processing speeds. This finding is significant in that it contradicts previous research which suggests that phonological overlap impedes bilingual language processing speeds. Moreover, findings from the SPL task suggest that syntactic overlap in cognates also facilitates bilingual language processing speeds when cognates are placed in sentence contexts. This finding is significant in that it contributes to research on syntactic overlap among cognates, which is an underrepresented topic in the field.

Conclusions: These findings can be applied in both educational and clinical settings. While educators can use cognates to aid bilingual children in reading, writing, and mathematics instruction, clinicians can use cognates to improve client understanding and to better inform tests which assess lexical (word) retrieval.

Keywords: cognate, bilingual, phonology, syntax, cognate facilitation effect

Introduction

Researchers estimate that over half the world is bilingual, which makes examining bilingual language processing an important and well-justified endeavor (Pearson, 2007). There exists on linguistic element in particular which has provided researchers with great insights into how bilinguals process language. This element is the cognate. Cognates are words which share meaning and form across languages. For example, “tomato” in English and its translation “tomaat” in Dutch are cognates (Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010). This paper will assess how bilinguals process cognates in regard to their phonological and syntactic overlap. In essence, this paper makes two main arguments. The first is that phonological overlap across cognates facilitates processing speeds when cognates are presented in isolation, contra to prior research. The second is that syntactic overlap across cognates also facilitates processing speeds when cognates are presented in sentence contexts (Fahey, 2020).

To understand bilingual language, it is importnat to consider the bilingual mental lexicon. The bilingual mental lexicon encompassess all the words that a bilingual knows. When tasked with processing language, a bilingual considers multiple factors which exist within this mental lexicon. These factors include orthographic (spelling), phonological (sound), and semantic (conceptual) representations. Researchers believe that it is best to imagine the bilingual mental lexicon as a three-dimensional landscape. Cognates exist as a connection between these orthographic, phonological, and semantic representations within this landscape (Dijkstra et al., 2010). Much research suggests that bilinguals process cognates faster than noncognates. This phenomenon is known as the cognate facilitation effect (Rosselli, Ardilla, Jurado, & Salvatierra, 2014). However, orthographic, phonological, and semantic overlap exist in differering degrees across cognates, which can influence the speeds at which bilinguals process cognates (Dijkstra et

al., 2010). Moreover, situating cognates in sentence contexts brings about an additional syntactic (grammatical) overlap, which also influences cognate processing speeds (Fahey, 2020).

The Language Identification (LID) Task

First, it is important to note that the data from the LID task suggests that phonological overlap among cognates presented alone (and not within sentences) facilitates cognate processing speeds in bilinguals. The LID task was conceived and created thanks to Dr. Danielle Fahey, who conducted her testing at the University of South Carolina and presented her findings in her 2020 dissertation entitled, "The Shape of the Bilingual Mental Lexicon: Testing the Cognate Continuum." The LID is being continued in its original form here at the University of Montana and research is ongoing. The LID presents Spanish-English bilingual participants with spoken verbs and asks them to recognize which language each word belongs to, as fast as possible while maintaining accuracy. These verbs include noncognates, lemma cognates (cognates which share syntactic overlap), lexemic cognates (cognates which share phonological overlap), and true cognates (cognates which share both syntactic and phonological overlap). In this experiment, researchers present participants with spoken audio files that read one cognate aloud at a time in isolation. After hearing a cognate, participants must indicate which language the verb belongs to using the keyboard, wherein hitting the "S" key indicates Spanish and the "E" key indicates English. The experiment continues until the participants respond to all 348 verbs, which are presented in a random order.

Although participants differ in their L1 (first acquired language) and L2 (second acquired language) statuses, participants self-reported these statuses in a questionnaire prior to engaging in the task, and these statuses are considered in analysis. In addition, all participants are required to have proficient understanding in both languages, given that the task includes some words which are not common (or are presented in lower frequencies) in the given languages.

Proficiencies were tested using the same questionnaire, as well as an additional speaking test. The speaking test being used is the TrueNorth speaking test. In this test, participants are required to score above the B1 level, which indicates that their understanding is proficient and could allow them to maintain basic comprehension in school, work, and personal settings in a region where that language is used.

Existing data indicates that participants overall process cognates around 41 milliseconds faster than noncognates, although this difference is more significant between Spanish cognates and noncognates rather than English. However, participants process the different cognate categories at different speeds. For instance, participants process true cognates and lexemic cognates at comparable speeds, with true cognates being processed in around 1319 milliseconds and lexemic cognates being processed in around 1320 milliseconds. However, participants process lemma cognates slower in comparison, with processing sspeeds averaging 1345 milliseconds. Participants processed noncognates in around 1368 milliseconds, which is a speed comparable to the aforementioned lemma cognates. Thus, it is apparent that the Spanish-English bilingual participants process lexemic cognates faster than lemma and noncognates on average. Furthermore, while participants process lexemic cognates at speeds comparable to the fastest-ranking true cognates, participants also process lemma cognates at speeds comparable to the slowest-ranking noncognates. Therefore, the LID task suggests that the phonological overlap present within lexemic cognates facilitates Spanish-English bilingual language processing speeds in isolation, and that lemma cognates provide no significant facilitation in isolation (Fahey, 2020).

Much research exists which supports the LID in its claim that phonological overlap in cognates facilitates bilingual language processing speeds. Researcheres who examine cognate effects between languages like Japanese and English, which do not share scripts (also known as

writing systems), find that phonological overlap is paramount in facilitating cognate processing speeds. For instance, researchers Nakayama, Verdonschot, Sears, and Lupker (2014) observed that phonological overlap among Japanese-English bilinguals facilitated language processing speeds overall. In this experiment, researchers found that when participants were presented with Japanese-English cognate pairings which had low phonological overlap, the participants processed them in around 703 milliseconds and made identification errors around 4.8% of the time. However, when researchers presented participants with cognate pairings which had high phonological overlap, the participants processed them much faster and made less identification errors. In fact, the participants processed the cognates with high phonological overlap in around 621 milliseconds and made identification errors around 2.2% of the time. Thus, this experiment suggests that the degree of cognate facilitation is dependent upon phonological overlap amongst Japanese-English bilinguals, which is consistent with the LID findings (Nakayama et al., 2014).

Arguments Against Phonological Facilitation

One argument which contradicts the LID comes from an experiment which Djikstra, Grainger, and Van Heuven conducted in 1999. In this experiment, researchers observed that phonological overlap did not facilitate, but rather impeded, cognate processing speeds in Dutch-English bilinguals. Researchers presented participants with three, four, and five letter English words which each shared strong phonological overlap with one possible Dutch cognate. These words appeared on a computer screen amongst much distracting visual input. Participants had to ignore those visual distractions to indicate where the word appeared on the screen. As a result, researchers found that participants identified the English words which shared significant phonological overlap with a Dutch cognate slower than the noncognate controls. Participants processed the words which shared this high phonological overlap in around 1780 milliseconds,

whereas participants processed the noncognate controls in around 1742 milliseconds (Dijkstra et al., 1999).

That being said, a significant drawback to the Djikstra et al. (1999) experiment is that it presents the target words in a visual, written format and not in an audible format. Thus, participants do not have a chance to hear the word and listen to its phonological influence in action. This experiment also presents the words in isolation and does not consider how sentence context could influence processing. Therefore, the experiment considers language processing in a limited sense, in that it dismisses the fact that much communication in real-worl scenarios occurs in spoken, conversational sentences where written cues might not be present. This critique can also be applied to multiple experiments which have also tested how bilinguals respond to stand-alone, written cognates (Kroll & Stewart, 1994; Van Heuven, Schriefers, Dijkstra, & Hagoort, 2008; Voga & Grainger, 2007) and not just the one which Djikstra et al. (1999) conducted. Thus, the LID and SPL provide much-needed expansions to the discouse on cognate processing, given their consideration for how audible language and sentence contexts impact cognate processing speeds in bilinguals (Fahey, 2020).

The Self-Paced Listening Task

All participants who complete the LID task are also required to complete the SPL task. The sole difference is that half the participants are assigned to complete the SPL task first. Thus, the same questionnaires, language proficiencies, and L1 versus L2 statuses which are considered in the LID task are also considered (and remain consistent) in the SPL task. Moreover, the same verb list used in the LID is also used in the SPL. However, rather than presenting these target verbs in isolation, this task instead presents the verbs in both English and Spanish sentences, so that English verbs are placed in English sentences and Spanish verbs are placed in Spanish sentences. A native and proficient English speaker wrote the English sentences, and researchers

with advanced Spanish proficiencies wrote the Spanish sentences. All the sentences provided 5 syllables before the verb and 5 syllables after the verb. The sentence is presented in segments, which the participant can click through and hear at their own pace using the spacebar. The sentences are also presented in a random order. Segment 1 contains a prepositional phrase or adverb, segment 2 contains a noun phrase, segment 3 contains a cognate (or noncognate) verb, segment 4 contains an object (presented in either a noun phrase or prepositional phrase), and the final segment 5 contains a prepositional phrase and a clause (Fahey, 2020). For example, an English sentence which Fahey (2020) provides in the task is: "Before (1) the sick kids (2) affected (3) their youngest new friends (4) by missing their homework, they gave them a call (5)" (p. 279). E-Prime 2.0 software records the time that the participants spend processing each segment. In addition, participants are required to answer comprehension questions based on the sentences, which are included after 1 in 4 sentences to assess understanding. These questions pertain to the aforementioned sentence (and not the task as a whole). For instance, as Fahey (2020) describes, the comprehension questions ask either "did you hear ___" or "oyó [usted] ___?" in the previous sentence (p. 168).

Existing data indicates that participants answer almost all comprehension questions correctly, no matter the language the question is presented in. On average, participantss also listen to sentences with a cognate verb faster than those which contain a noncognate verb, no matter the language. Fahey (2020) predicted that, should phonological overlap alone impact processing speeds, then true and lexemic cognates would be processed at comparable speeds, lemma cognates would be slower, and noncognates would be the slowest. However, that prediction is not consistent with existing data. Rather, existing data shows that participants process true cognates faster than lexemic cognates across languages. Participants process Spanish true cognates around 211 milliseconds faster than Spanish lexemic cognates on average,

and participants also process English true cognates around 37 milliseconds faster than English lexemic cognates on average. In contrast, participants process lemma cognates slower than true and lexemic cognates on average. Participants process Spanish lemma cognates around 12 milliseconds slower than Spanish lexemic cognates on average, and participants also process English lemma cognates around 174 milliseconds slower than English lexemic cognates on average. Thus, this sequence suggests that the syntactic overlap among lemma cognates does impact processing, because it has a facilitative impact which is seperate than, but comparable to, the speed differential between true and lexemic cognates. All in all, these results suggest that syntactic overlap among cognates facilitates language processing speeds among bilinguals when cognates are presented in sentence contexts (Fahey, 2020).

The SPL is not the first task which suggests that syntactic structure impacts cognate processing speeds. For example, researchers Schwartz and Kroll (2006) also considered how cognate processing speeds could change based on their surrounding sentence structure. Their experiment observes that bilinguals name cognates placed in “high-constraint” sentences, which provide ample context clues to indicate a target word, faster than cognates placed in “low-constrain” sentences, which provide little to no information to indicate a target word. Thus, this research aligns with the SPL in its indication that sentences should be considered in cognate processing, given their observable impact on processing speeds (Schwartz & Kroll, 2006).

Conclusions, Clinical Implications, and Future Directions

All in all, this paper uses the LID and SPL tasks to observe that phonological overlap across cogates facilitates bilingual laguage processing speeds and syntactic overlap across cognates also facilitates bilingual language processing speeds when cognates are presented in sentences. Thus, educators and clinicians interactig with bilingual clients should use cognates to

their advantage, given that cognates could both improve biligual second language education as well as clinical treatment (Fahey, 2020).

In educational settigs, understanding cognates can be a significant asset. For instance, educators teaching children can at times percieve that bilingual children are at a disadvantage, their their perception that bilingual children must learn two separate vocabularies (Bialystok, Craik, Green, & Gollan, 2009). However, research on cognates refutes this perception. Rather, cognate facilitatio suggests that these two vocabularies are not seperate in the mind, but instead exist in an integrated lexicon (Djikstra & Van Heuven, 2002). The integrated lexicon could help explain research which suggests that bilingual children can improve their reading skills in both languages, even when reading in just one language. Moreover, this improvement can be seen not just in languages which share scripts, like English and Spanish, but also in languages which do not share scripts, like English and Japanese. Thus, the cognate facilitatio effect could help educators overcome the misconception that bilingual children are at a disadvantage when it comes to education in reading and writing (Pearson, 2007). Furthermore, it is important that educators do not view native languages as problems which impede and must be replaced with the target language. It would be a disservice to the student to ignore their native language in second-language reading and writing instruction, given that the cognates between these languages can provide significant benefits to bilingual students. After all, using cognates can allow bilinguals to draw upon previous knowledge, given that cognates are words which might at present exist within their native listening and readig vocabularies. As it stands, educators can use cognates to help students learn noncognates. As Rodríguez (2001) explains, presenting a Spanish-English bilingual student with a sentence like, “The water from the flood destroyed the hospital,” might be easier for them to comprehend given that “hospital” and “destroyed” are Spanish-English cognates. From there, the student can better understand what “water,” a noncognate, means (p.

744). Moreover, providing cognates in the classroom can also help bilingual children learn mathematics. Given that terms in mathematics often have Latin roots, the Spanish-English cognate list among these terms is massive. For instance, “division” in English corresponds to “división” in Spanish; “hexagon” in English corresponds to “hexágono” in Spanish; “circumference” in English corresponds to “circumferencia,” and so on. Thus, it is unsuprising that Spanish-English bilingual students benefit from cognate instruction as it relates to mathematics. For instance, when teachers inform native Spanish speakers that the suffix “gon” translates to “gono,” which means “side” in Spanish, the students are nore efficient in understanding English vocabularies in respect to geometric shapes. Therefore, cognates can provide significant aid to bilingual classrooms in instructing reading, writing, and mathematics (Gómez, 2010).

Furthermore, understanding cognates can be a significant asset to those working with bilinguals in clinical settings. Monolingual clinicians communicating with bilingual clients should consider using cognates, as these could help boost client understanding (Edmonds & Kiran, 2006). Moreover, research suggests that clinicians who use standard assessments which test lexical retrieval should consider how cognates might impact bilingual test results. For example, the Boston Naming Test (BNT) is a popular tool used among clinicians to test lexical retrieval. However, a bilingual who is less proficient in a target language might score lower when presented with significant amounts of noncognate words, but that same bilingual might score higher on the same test when presented with significant amounts of cognate words. Thus, it is important to consider cognate numbers amongst testing stimuli, as these might skew test results to be either lower or higher than normal (Rosselli et al., 2014).

In summation, experiments like the LID and SPL are important because these experiments provide depth to pre-existing research on cognates, in that the LID suggests that

phonological overlap among cognates facilitates language processing and the SPL suggests that syntactic overlap also facilitates processing when cognates are presented in sentence contexts, and these facilitations can be used to better inform educational and clinical treatment. Future research should continue to examine syntactic influences on cognate processing, given that this is an underrepresented topic in the discourse. Furthermore, future research should also consider presenting cognates to participants in an audible format, rather than a written format, given that experimental designs with aduible stimuli are also underrepresented in cognate research (Fahey, 2020). At last, it is important to note that this research examines Spanish-English cognates, which represent Latin-based languages that share the same script (Rosselli et al., 2014). These languages are well-represented in discourse on cognates, whereas languages which are not Latin-based and do not share the same script are marginalized in cognate research. Thus, it is critical that future research examines these marginalized languages so that research on cognates is expanded to consider more diverse bilingual populations (Nakayama et al., 2014).

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