How Second Language Learning is Helped and Hurt by Native Language Similarity

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Abstract

Because learning a second language (L2) is difficult, many learners start with easy words that look like their native language (L1) to jumpstart their vocabulary. However, this approach may not be the most effective strategy in the long-term, compared to introducing difficult L2 vocabulary early on. We examined how L1 similarity affects pattern learning in L2 by teaching English monolinguals either an Englishlike or Non-Englishlike artificial language that contained repeated patterns. We found that the first words that individuals learned in an L2 influenced which words they acquired next. Specifically, learning a new word in one session made it easier to acquire a similar word in the next session. L2-similarity interacted with L1-similarity, so that words that looked more like English were easier to learn at first, but they were less effective at influencing later word learning. This demonstrates that although native language similarity has a beneficial effect early on, it may hinder long-term learning by decreasing recognition of repeated patterns within a second language. This surprising finding demonstrates that making early learning easier may not be the most effective long-term strategy. Learning difficult vocabulary teaches the learner what makes the new language unique, and this general language knowledge about language structure is more valuable than the words themselves. We suggest that difficulties during learning are not always to be avoided, as additional effort early on can pay later dividends.

Keywords: Language; Learning; Second language acquisition; Cross-language similarity; Psycholinguistics

Introduction

For adults, learning a second language (L2) is often a difficult task, requiring considerable time (Liskin-Gasparro, 1982). It is estimated that you need to know over thirty thousand words to comprehend a language fluently (Nation, 2006; Schmitt, Jiang, & Grabe, 2011); not surprisingly, many learners are constantly on the lookout for tips and tricks to make learning easier and build up their vocabulary. However, it is important to distinguish between making learning easier, and making learning more effective. Memory research has shown that easier is not necessarily better, as introducing certain desirable difficulties during learning can improve long-term retention (E. L. Bjork & Bjork, 2011). Introducing frequent tests or variable learning contexts can cause initial performance on a task to drop relative to easier methods, but when long term performance is assessed, more difficult tasks may be more effective than easier tasks, due to engaging the learning system differently. Many of these same desirable difficulties have also been shown to benefit long-term vocabulary learning in a second language (R. A. Bjork & Kroll, 2015; Schneider, Healy, & Bourne, 2002) by more fully engaging the learning system. In the current study, we extend the concept of desirable difficulties in L2 learning from task structure to lexical properties, by examining the effectiveness of similarity within and across languages during vocabulary learning.

Native language similarity can be a useful language learning resource. Contrastive analysis that highlights similarities and differences between the L1 and L2 can be highly effective (Laufer & Girsai, 2008; Lin, 2015), and adult language learners readily identify L1 similarities (Ringbom & Jarvis, 2011). The way that similarities to the L1 can aid L2 learning has often been examined experimentally using artificial languages, in order to closely control the amount of overlap between the known language and the new language. Vocabulary learning is facilitated when novel words are designed to either reuse native letter or sound patterns (i.e., frequent bigram or biphone probabilities) or closely resemble a large number of native words (i.e., large neighborhood size) (Bartolotti & Marian, 2017; Storkel, Armbrüster, & Hogan, 2006; Thorn & Frankish, 2005).

However, similarities between languages can introduce costs when they are over-applied or block acquisition of new features during learning. For example, a German learner of English may say, "I need a loffel for my soup," under the mistaken belief that the German word Löffel (meaning spoon) is an English cognate (Eckman, 2004). In other cases, similarity to the L1 can interfere with complete acquisition of an L2 feature. For example, L2 sounds that are similar to an existing L1 sound are actually more difficult to pronounce accurately than completely new sounds (Flege, 1987). Even speakers who have mastered L2 phonology still pronounce cognate words (which have similar forms and meanings across languages) with more of an accent than non-cognates, due to cognates' high L1 similarity (Amengual, 2016). Essentially, when the native language takes the place of important new knowledge, it can start to do more harm than good.

Key to long-term success mastering an L2 is recognition and use of L2-specific patterns, allowing the learner to no longer depend on the L1 and instead develop reusable L2 knowledge. Adults who had completed one year of university-level Spanish courses were able to learn new words with a large number of Spanish neighbors (i.e., words that differed from many Spanish words by only a single phoneme) at a higher rate than words with a low number of Spanish neighbors (Stamer & Vitevitch, 2012). This ability to learn words with more L2 neighbors provides evidence that similarities within an L2 benefit learning. As proficiency in the L2 increases, so too does the strength of this within-L2 similarity effect (Ma, Chen, Lu, & Dunlap, 2015), creating a positive feedback loop where L2 word learning becomes easier as L2 vocabulary size increases.

We propose the concept of 'bridge' words as an L2 learning resource that can teach learners about useful features in the L2. Bridge words are defined as L2 vocabulary that contain common L2 patterns to facilitate subsequent L2 learning. Acquiring a bridge word (e.g., *haner* in the current study) may make it easier to learn a similarly spelled 'terminus' word (e.g., *hajer*) to which it is connected because of feature overlap. Some bridge words use features that are also common in the L1, which may make them easier to acquire, whereas other bridge words are composed of features that are uncommon in the L1. To examine the effect of L1 similarity on bridge words' utility, we designed two contrasting artificial languages and taught participants one of the two languages across two sessions. Participants were first taught bridge words in either a Familiar language with high English similarity (e.g., *haner*, meaning *bride*) or an Unfamiliar language with low English similarity (e.g., *vobaf*, meaning *cloud*), followed by an immediate test where they produced the new word when cued with its meaning. Two weeks later, participants returned to learn terminus words that were related to their previously-learned bridge words (e.g., *hajer*, *tobaf*), and were again tested immediately. If we observe a general benefit for terminus word acquisition based on bridge word knowledge, it would suggest that language learners are able to use similarities within the L2 to facilitate subsequent L2 learning. Critically, if we observe different effects of bridge words in the Familiar and Unfamiliar languages, it would suggest that L1 similarity can modulate how L2-specific knowledge is used. L1 similarity may improve bridge-to-terminus transfer, by accentuating word-to-word similarity as a learning tool, or it may interfere, by hindering acquisition of L2 patterns.

Methods

Participants

Sixty-five English-speaking adults initially participated after providing informed consent in accordance with the university's institutional review board, and were randomly assigned to learn a Familiar or Unfamiliar language. The final sample included 38 English monolinguals, after excluding participants with L2 proficiencies of 3 or greater on a scale of 0-10 (LEAP-Q, Marian, Blumenfeld, & Kaushanskaya, 2007). The Familiar language group (N = 17) and Unfamiliar language group (N = 21) did not differ in nonverbal IQ (matrix reasoning subtest of the Wechsler Abbreviated Scale of Intelligence, PsychCorp, 1999) or verbal memory (verbal paired associates test of the Wechsler Memory Scale III , Wechsler, 1997), $ps > .1$.

Materials

The Familiar and Unfamiliar languages each contained 96 five-letter words with alternating consonants and vowels in CVCVC format (excluding the letters Q, Y, and X). Each language contained two 48-word lists, one per training session. Vocabulary items in the first list (Bridge words) were used to examine L1 influences on L2 learning; the second list (Terminus words) examined the effect of within-L2 similarity on novel L2 word learning. For the Familiar language, 48 randomly generated words were created with high English similarity scores, defined as mean English bigram and biphone probabilities (z-transformed) above the 20th percentile score for real English five-letter words. For the Unfamiliar language, 48 randomly generated words were created with low English similarity scores (below the 99th percentile). Bigram and biphone probabilities were calculated using CLEARPOND (Marian, Bartolotti, Chabal, & Shook, 2012), and phonological forms of each novel word were determined using the eSpeak speech synthesizer software, version 1.48.15 for Linux (Duddington, 2012). An additional 48 novel words in each language were designed for use in the second session. All new words were substitution neighbors of a single item from that language's first list, and all new words had low English similarity scores (below the 99th percentile); the large drop in English similarity from the first to the second list in the Familiar language was driven by decreases in average bigram and especially biphone probabilities.

All novel words were assigned an English meaning for use during learning; the Familiar and Unfamiliar languages both used the same list of 96 English words. To control for effects of individual novel-word English-word pairings, two variants were created for each language that were counterbalanced across participants. The 96 English words were divided into two lists that were matched for lexical frequency on the SUBTLEX-US zipf scale (Brysbaert & New, 2009; Van Heuven, Mandera, Keuleers, & Brysbaert, 2014) as well as concreteness and familiarity (Bristol norms) (Stadthagen-Gonzalez & Davis, 2006), all $ps > .05$.

Procedure

Participants learned the novel language they were assigned to over the course of two sessions spaced two weeks apart. In each session, participants were given a sheet of paper containing all 48 novel words and their meanings printed as paired associates (e.g., furen – stone). Participants were provided 16 minutes to silently learn as many words as they could, and were told that they would be tested immediately afterwards.

Participants were then given 6 minutes to write the matching novel word translations on a response sheet containing all 48 English meanings. A research assistant later manually transcribed written responses onto a computer, which automatically scored participants' accuracy.

Data Analysis

Responses were scored .2 points for each correct letter in the correct position, for a maximum score of 1 per word. Accuracy was analyzed with linear mixed effects-regression, using the lme4 package (Bates, Machler, Bolker, & Walker, 2014) in R (R Core Team, 2016). Models included random effects of both participants and items. Significance of fixed effect estimates was evaluated using the Satterthwaite approximation for degrees of freedom. Followup comparisons on models' predicted marginal means (using Welch t-tests) also used the Satterthwaite approximation for degrees of freedom, and the Tukey correction for multiple comparisons.

Results

The effects of between and within language similarity on vocabulary learning in a new language were analyzed using a linear mixed-effects regression model with fixed effects of Language (Familiar, Unfamiliar) and Session (Bridge word, Terminus word), plus an interaction term, and random intercepts of participant (intra-class correlation = .10) and item (intra-class correlation = .08). We found a significant interaction (*Estimate* = -15.67, *SE* = 3.52, $t(222.9) = 4.46$, $p < .001$), as well as main effects of both Language (*Estimate* = 10.47, *SE* = 4.12, $t(47.7) = 2.55$, $p < .05$) and Session (*Estimate* = -6.73, *SE* = 1.82, $t(191.2) = 3.71$, $p < .001$) (Figure 1). Followup comparisons on the model's predicted marginal means revealed that accuracy for the Familiar language in the Bridge session, $M = 34.22$, $SE = 3.32$, was higher than for the Unfamiliar language in the Bridge session, $M = 16.12$, $SE = 3.04$, $t(66.6) = 4.02$, $p < .001$, and higher than accuracy for either the Familiar language, $M = 19.77$, $SE = 3.29$, $t(224.8) = 5.63$, $p < .001$, or the Unfamiliar language in the Terminus session, $M = 17.34$, $SE = 3.05$, $t(66.9) = 3.74$, $p < .01$. No other comparisons were significant.

The higher accuracy in the Bridge session for the Familiar language compared to the Unfamiliar language demonstrates a substantial benefit of native language similarity during self-directed vocabulary learning in a second language. However, the better learning observed for the Familiar language did not carry through to the subsequent Terminus session, at which point there was no significant difference between word retrieval accuracy in the two groups.

The Terminus session contained entirely new vocabulary for participants to learn; all words were single letter substitution neighbors of words from the Bridge session (e.g., bridge word *haner* and terminus word *hajer*). To determine whether vocabulary that individuals learned in the Bridge session transferred to the Terminus session (i.e., a within-language similarity effect), we used a model that included

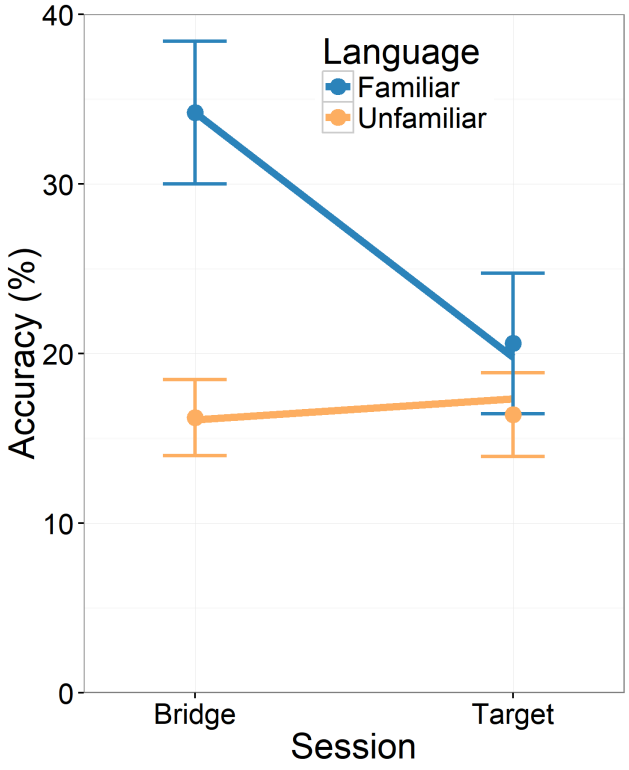

Figure 1: Word learning accuracy. In the Bridge session L1 similarity helped, as more words were learned in the Familiar language (dark blue) than the Unfamiliar language (light orange). Dots and error bars represent observed values and standard error by participants. Lines represent estimated marginal means from the linear mixed-effects regression model.

fixed effects of Language (Familiar vs Unfamiliar) and L2-Knowledge (contrasts: Known vs Unknown Neighbor, and Known vs Partly-Known Neighbor) plus interactions. Items in the Known Neighbor condition were substitution neighbors of bridge words that an individual got 4-5 out of 5 letters correct in the prior session. The Partly-Known Neighbor condition included neighbors of bridge words with a score between 1 and 3 letters correct, and the Unknown Neighbor condition included neighbors of bridge words that got a score of 0 letters correct. Note that items were assigned to L2-Knowledge conditions individually for each participant based on their performance in the Bridge session, and thus conditions have an unbalanced number of items (Familiar language: 28.5% Known Neighbor, 22.6% Partly-Known Neighbor, 53.6% Unknown Neighbor. Unfamiliar language: 11.0% Known Neighbor, 17.4% Partly-Known Neighbor, 71.6% Unknown Neighbor). Analyzing percent accuracy in each L2-Knowledge condition allowed us to control for differences in baseline Bridge word knowledge across languages.

We found a significant interaction between Language and L2-Knowledge (Known vs Partly-Known contrast, *Estimate* = 5.96, *SE* = 3.01, $t(1677.6) = -1.98$, $p < .05$) and a main

effect of L2-Knowledge (Known vs Unknown contrast, *Estimate* = 4.06, *SE* = 1.23, $t(1709.6) = 3.30$, $p < .001$; Known vs Partly-Known contrast, *Estimate* = 2.87, *SE* = 1.51, $t(1677.6) = 1.91$, $p = .056$) 2. Follow-up comparisons on the model's predicted marginal means revealed that accuracy for Known Neighbor words in the Familiar language, $M = 26.11$, $SE = 4.07$, was higher than for Unknown Neighbor words, $M = 17.42$, $SE = 3.72$, $t(1692.3) = 2.83$, $p < .05$. Accuracy for Known Neighbor words in the Unfamiliar language, $M = 28.76$, $SE = 4.480$, was higher than for either Partly-Known Neighbor, $M = 13.22$, $SE = 3.99$, $t(1685.2) = 3.70$, $p < .001$, or Unknown Neighbor words, $M = 15.38$, $SE = 3.27$, $t(1702.6) = 3.71$, $p < .001$. Accuracy for Partly-Known Neighbor words in the Familiar language was $M = 21.85$, $SE = 4.39$, and did not differ from any other conditions. The size of the L2 similarity effect (i.e., accuracy for words with Known versus Unknown neighbors) was larger in the Unfamiliar, $M = 24.01$, $SE = 7.30$, compared to the Familiar language, $M = 7.14$, $SE = 2.87$, $t(24.6) = 2.15$, $p < .05$, suggesting that similarity within the L2 influenced the types of words that people learned in the Unfamiliar language more than in the Familiar language.

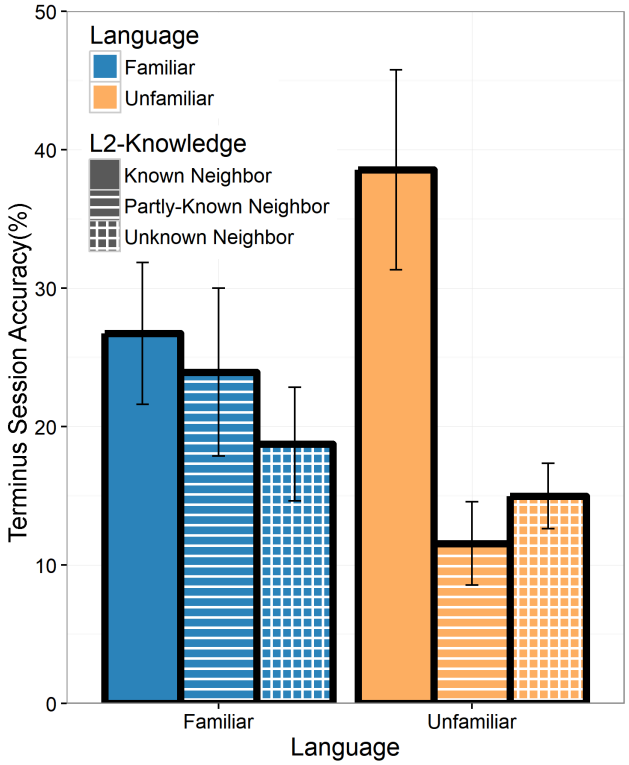

Figure 2: Within-L2 similarity influences learning. Likelihood of learning a word in the Terminus session was affected by how well one learned the word's neighbor in the Bridge session. Each group was more likely to acquire a word after learning its neighbor in the Bridge session (Known Neighbor) compared to not learning its neighbor (Unknown Neighbor). Accuracy in the Unfamiliar language (light orange) was also higher for Known Neighbor words than for Partly-Known Neighbor words. Values and error bars represent observed data and standard error (by participants).

Discussion

The goal of the present study was to determine how similarity to the native language influences acquisition of second language words and patterns. We found that although L1-L2 similarity provides short-term L2 learning benefits, it may impede L2 pattern recognition important for long-term learning. Through continued use of an L2, the learner recognizes new patterns that determine how letters or sounds can combine to form words, and how words combine to form sentences. This process of extracting patterns in another language is also important for establishing continuous vocabulary learning, by ensuring that new words are accurately perceived and encoded in memory. Advanced L2 learners have been shown to benefit from L2 similarity during word learning (Ma et al., 2015; Stamer & Vitevitch, 2012), and in the current study, we found that within-L2 similarity can also affect the earliest stages of vocabulary learning in a new language. Specifically, learning a word in the first session increased the likelihood that a similar word would be acquired in the subsequent session. Notably, while words that resembled the L1 were easier to learn at first, they had less of an influence on subsequent L2 word learning. These results demonstrate the important roles of both the L1 and the burgeoning L2 on vocabulary acquisition in an L2.

Because of the way the novel languages in our study were designed, each word in the bridge session had a single substitution neighbor in the subsequent terminus session. These bridge-terminus word pairs allowed us to assess differences in word learning based on whether or not the learner already knew a similar word. Importantly, this is based not on intrinsic properties of the words, but instead on learners' idiosyncratic knowledge of the new language. Given the self-directed nature of the training session, the within-L2 similarity effect that we observed may reflect how attention and study time were allocated to new words. Because overall accuracy did not improve between bridge and terminus sessions, the observed advantage for terminus words with already-acquired bridge neighbors comes at the expense of words with unlearned neighbors, consistent with prior self-directed word learning paradigms (Bardhan, 2010). Being able to predict how second language learners are likely to direct their attention across study sessions has useful applications for individualized language instruction, which can build off of learners' acquired L2 knowledge.

Notably, learners of the Familiar and Unfamiliar languages differed in how much within-L2 similarity affected their continued learning. Even though bridge words in the first session were learned twice as well in the Familiar language compared to the Unfamiliar language, the within-L2 similarity effect in

the terminus session was nearly twice as large for learners of the Unfamiliar language. In the Unfamiliar language, terminus words with learned bridge word neighbors were recalled with 2.65 times greater accuracy than words with unlearned bridge neighbors, compared to only a 1.51 times advantage in the Familiar language. These terminus words in the second session were carefully designed to have equally low English similarity in both languages, ensuring that this terminus word difference was due to effects of within-L2 similarity, without confounding L1-L2 similarity. These results indicate that although L1 similarity provided a clear initial benefit for word learning, it had diminishing returns with continued study.

Retention of bridge words between sessions was not tested in order to avoid priming bridge word knowledge in a way that influenced terminus word recall. As a result, an alternative explanation for the larger within-L2 similarity effect in the Unfamiliar language is that Unfamiliar bridge words decayed more slowly than Familiar bridge words, leading to more opportunities for within-L2 similarity effects during the terminus session. Because a relatively large forgetting effect size would be necessary for Unfamiliar bridge words to overtake Familiar bridge words, differences in forgetting are unlikely to be the sole contributor to the observed within-L2 similarity effect, but future work should consider how L1 similarity interacts with both learning and forgetting.

Part of the task of learning a second language involves mentally distinguishing it from the L1 so that it can be used as a separate system. Bilinguals rely on language membership cues including letter and bigram frequencies to guide speech production, (Oganian, Conrad, Aryani, Heekeren, & Spalek, 2015); monolinguals do so as well, and will attempt non-native pronunciations for town names that they perceive to be of foreign origin based on their spellings (Fitt, 1995). Participants in the current study who learned the Familiar language did not have reliable cues to indicate that the novel bridge words were non-English. This may have stalled the process of linking new words into a coherent L2, interfering with transfer between the bridge and terminus words. In contrast, learners of the Unfamiliar language were acquiring an L2 that was unambiguously distinct from English. This distinction appears to be helpful in promoting extraction of L2-specific patterns to be used during learning.

The within-L2 similarity advantage for the more difficult of the two languages also bears resemblance to the idea of desirable difficulties during learning (E. L. Bjork & Bjork, 2011). In language learning, when material is presented in a more difficult context, long-term retention is generally improved (R. A. Bjork & Kroll, 2015; Schneider et al., 2002). Examples of desirable difficulties include repeated testing in place of passive study, or interleaving blocks of different word lists rather than blocked study. Our results suggest that difficulties caused by properties of the words themselves may also be targets for increasing long-term learning.

In conclusion, we found that second language vocabulary learning is affected by both similarity to one's native language and similarity within the new language. Whereas native language similarity has a beneficial effect early on, it may have diminishing returns over the long-term due to lower recognition of repeated patterns within a second language. Notably, the words that one successfully learns in a second language early-on can influence the words that one acquires later, by driving attention towards new words that look more like already acquired ones. This suggests that initial vocabulary learning could potentially have cascading effects on the makeup of one's subsequent vocabulary in a new language. Overall, these results demonstrate the complex relationship between first and second languages during learning, where even helpful overlap between languages can have unexpected side-effects.

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