Training and Transfer of Word Identification: Foreign Language Speech Rate

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This study examined effects of speech rate on the training and transfer of foreign language word identification. Speeds of initial training and test speech were varied, allowing for analysis of the relative effects of training difficulty and training specificity on a practical task—learning to map words to orthography in a new language. Participants were trained to identify words in Spanish sentences at one of 3 speech rates and tested at all 3 rates with new and old sentences. During training and testing, participants who learned at the fastest rate were less accurate at word segmentation than those who learned at medium and slow rates. There were no significant differences in segmentation accuracy between participants who trained at slow and medium speeds. Results do not support the difficulty of training principle but do support specificity of training for target words and grammatical structures although not for speech rate.

General Audience Summary

The way in which facts and skills are presented to students can have important effects on both how well they are learned and how likely students are to remember them. Surprisingly, making initial learning of facts and skills more difficult can sometimes lead to better memory for what is learned and better ability to transfer learning to new situations. This finding is called the difficulty of training principle. In addition, previous research has shown that people may remember facts and skills best when test conditions and learning conditions are very similar. This finding is called the specificity of training principle. In the current study, different speech rates were used to test these two principles with a practical task—learning to match the sounds and written forms for foreign language words. Would faster speech (more difficult) lead to better memory for words that were learned? Would similar speech rates (fast and fast; slow and slow) or similar content (same words or grammar) lead to better learning? Results suggest that slowing speech is not helpful for this aspect of language learning, even for beginning learners. However, making training more difficult by speeding up speech during learning (relative to normal speeds) also did not help students' learning or memory. In contrast, using similar content during training and testing did aid learning, supporting the specificity of training principle.

A number of principles with practical implications for the science of learning have been identified (Brown, Roediger, & McDaniel, 2014; Graesser, 2011; Healy, Kole, & Bourne, 2014). The current study examines the interaction of two such principles, *difficulty of training* and *specificity of training*, on one aspect of foreign language word learning. The difficulty of training principle suggests that certain types of difficulty encountered by a learner during study might lead to both better long-term retention of information and more effective transfer of learning (e.g., Bjork, 1994; Bjork & Kroll, 2015; Schneider, Healy,

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& Bourne, 2002). The specificity of training principle argues that both retention and transfer of learning are most effective when conditions at test match those during training (e.g., Healy & Wohldmann, 2012). However, it is not clear which types of conditions must match to best promote transfer. Thus, the current study considers two different types of matching—one a function of presentation (speed) and the other of content (words/grammatical structures).

Foreign language word learning was used as the task for this study for several reasons. First, it provided a challenge similar to one that learners might encounter in school and, thus, might find motivating. Second, by controlling previous exposure to a new language, it was possible to evaluate initial learning. Third, speech rate has been previously investigated for its practical implications on foreign language teaching and learning. Thus, results of the current study may help to inform (a) the effects of training specificity and training difficulty on a task mapping between the phonetic input and the orthography of the words and (b) the effect of speech rate on initial foreign language word learning. Finally, varying speech stimuli allowed for a comparison both of difficulty and of specificity within a single design. Specifically, speech rate served as a manipulation of both task difficulty and specificity of transfer (match of test speed to training speed). Simultaneously, speech content was used as another measure of specificity (comparing transfer of previously encountered content words and grammatical structures to untrained stimuli). In this way, two types of specificity—presentation (speed) and content (words/structures) could be assessed within a single study.

Training Principles

According to the difficulty of training principle, difficult training can slow acquisition of information but facilitate both retention and transfer of that information in subsequent tests (e.g., Bjork, 1994; Bjork & Kroll, 2015; Schneider et al., 2002). However, not all difficulties encountered during training can be expected to enhance later test performance, only those that have been shown to be "desirable." Determining which difficulties are desirable and what are the boundaries of the difficulty of training principle has been the object of considerable research (e.g., McDaniel & Butler, 2011; McDaniel & Einstein, 2005; Young, Healy, Gonzalez, Dutt, & Bourne, 2011).

According to the specificity of training principle, performance at test will be best when conditions at training correspond with conditions at test (e.g., Healy & Wohldmann, 2012). However, again, not all aspects of training need to correspond with those at test for training to be effective. Recent research has begun to explore this issue by systematically examining different dimensions of training to see which ones require a match between training and testing, finding that it is more important to match cognitive and perceptual dimensions than to match the motoric dimension (Healy, Schneider, & Barshi, 2015).

The two principles of difficulty and specificity of training do not always coincide in their predictions regarding optimal training conditions. In one recent study (Schneider, Healy, Barshi, & Bourne, 2014), the relative merits of these two principles were contrasted when they yielded different predictions for the training of the task of following navigation instructions, and specificity of training was found to have a greater impact on test performance than difficulty of training. However, the relative importance of the two training principles doubtless depends on the aspects of training being manipulated. The length of training messages used in the navigation task was manipulated in the study by Schneider et al. (2014), rather than the rate of presenting the messages. Different findings might result when message rate rather than message length is varied and when the focus is on word identification rather than understanding navigation instructions. Thus, the question remains whether in training word identification it is most advantageous to train with speech at a more difficult (fast) rate than at an easier (slow) rate.

Foreign Language Speech Rate

Understanding speech involves a number of important steps. The listener must segment the incoming sound stream into separate lexical items, analyze the message syntactically, and construct higher-level meaning representations. For foreign language learners, this comprehension process might be complicated by inadequate vocabulary, misanalysis of syntactic structure, or misclassification of phonemes. To help non-native listeners, many speakers resort to so-called "foreigner talk," characterized by the use of simplified grammar, increased pauses, and slowed speech rate (e.g., Derwing, 1990; Hatch, 1983; Long, 1981). As such, "foreigner talk" represents one form of the larger concept of modified or simplified input within the second language (L2) acquisition tradition (Kelch, 1985).

Although slowing speech down is preferred by both speakers and listeners for speech presented to foreign language students (e.g., Derwing, 1990; Meinardi, 2009; Zhao, 1997; but also see Derwing & Munro, 2001), based on the principles of training reviewed above, we hypothesized that practicing at a slower speed might actually hinder subsequent processing of normally presented speech, which often seems quite rapid to the foreign language learner. Thus, training with normal rate speech (specificity of training) or with speech faster than normal (difficulty of training) might prove more helpful, at transfer, than training at slower speeds. Previous research in other domains involving complex skills has shown that training at higher than normal speeds can improve learners' subsequent ability to process information presented at a normal rate. For example, "above real speed" training has been explored for air combat skills (Crane, Guckenberger, Schreiber, & Robbins, 1997).

Few existing studies have examined the role of speech rate on L2 listening comprehension (see Table 1). That results from these studies are mixed is not surprising due to differences in type of rate manipulation (e.g., slowing speech mechanically vs. adding pauses), definitions of "fast" and "slow," L1–L2 pairs, levels of L2 proficiency, and experimental tasks.

Present Study

Previous experiments have examined L2 speech perception in both laboratory and naturalistic environments. In these experiments, however, all participants had some knowledge of the