**Moving beyond two languages**

The effects of multilingualism on language processing and language learning

Jared Linck, PhD, Erica Michael, PhD, Ewa Golonka, PhD, Alina Twist, PhD

From diplomatic negotiation to translation of foreign communications to interpreting in conflict zones, language skills are vital to national security. Because it is sometimes difficult to predict which languages will be of strategic importance in the future, U.S. Government agencies need to select and train personnel in new languages as quickly as possible. A common strategy is to identify personnel who are already working in a foreign language and train them in a new language, an approach known as cross-training, which includes conversion.¹ Research on cross-training per se is very limited and consists primarily of a few documented cases of cross-training courses that were shorter than regular courses but produced similar results. The currently available evidence from the fields of psycholinguistics and Second Language Acquisition (SLA) suggests that multilingual learning can be affected by an individual’s cognitive control and overall proficiency in previously learned languages, and that previous linguistic knowledge and language learning experience can also affect the individual’s learning of consecutive languages. In particular, it has been documented that language similarity of the L3 to any known language may improve learning. However, little is known about specific ways to achieve successful cross-training via multilingual pedagogy. The goal of the current report is to open a new avenue of investigation by considering multilingual cross-training issues from a psycholinguistic perspective by reviewing the existing literature on the processing and acquisition of multiple languages.

Over the last 30 years, a growing body of psycholinguistic research has been devoted to the study of bilingual language processing and second language (L2) acquisition. Although the term “L2” is often used in the scientific literature to refer to any language other than one’s native tongue (L1), relatively little research has focused on issues that are specific to learning or processing a third language (L3) or beyond. In this report we review existing research on the psycholinguistic and cognitive factors that may affect the learning and use of languages beyond the L2. Before we begin, it is important to clarify terminology:

- **L1**: one’s native language or mother tongue; the language learned from birth; individuals who are raised in multilingual environments may consider themselves to have multiple L1s
- **L2**: a language that is learned sometime after the L1; it may be learned as a child or as an adult, in a formal setting such as a classroom or an informal setting such as a grandparent’s home

¹ Whereas conversion training refers to learning a language that is highly related to an already known language (e.g., moving from Spanish to Portuguese), cross-training is a broader term for leveraging existing knowledge of any non-native language for purposes of learning a new foreign language.
L3: any language beyond the second (sometimes also referred to as Ln); for example, if a native English speaker studies Spanish in high school, German in college, and Arabic on the job, both German and Arabic would be considered L3s

Bilingual: having some degree of proficiency (not necessarily native-like) in two languages, regardless of age of acquisition; balanced bilinguals have near equal proficiency in the two languages, whereas unbalanced bilinguals exhibit dominance of one language over the other

Multilingual: having some degree of proficiency in more than two languages

We begin this report with a brief description of various psycholinguistic theories, models, principles, and findings from the large literatures on bilingualism and second language acquisition that are particularly relevant to the discussion of L3 issues. Before turning our attention specifically to cross-training, we summarize some of the key research on multilingual language processing in individuals who have already attained some degree of proficiency in an L3. The goal of this first section is to better understand how multiple languages interact in the human mind in the hopes that such research will help shed light on some of the cognitive constraints and other factors that may have consequences for learning an L3. In the second section, we review the literature on multilingual learning, focusing on some of the ways in which previous language-learning experience may facilitate or interfere with L3 learning. Finally, we discuss multilingual pedagogy by considering how L3 instruction (i.e., cross-training) might be informed by the research described in the earlier sections.

THE MULTILINGUAL MIND

Cognitive models and multilingual extensions

Theoretical models of the bilingual mind (including models of the lexicon, language processing or learning) provide an understanding of how an L2 is learned and processed, which can inform language pedagogy. Considering how these models can accommodate the multilingual mind can further inform our understanding of multilingualism. To date, the most extensive psycholinguistic research has focused on lexical (i.e., single-word) comprehension and production processes. As such, we ground our discussion on models of the bilingual lexicon to demonstrate how research on bilingual learning and processing can be extended into multilingual situations. As will be discussed below, some existing models can accommodate the multilingual case without the need for modifications. However, for some, modifications to the model’s assumptions or mechanisms are required to appropriately address phenomena that arise when a third language is involved. These potential modifications lead to testable predictions that do not emerge from considering only the bilingual case, and provide an opportunity for new insights about multilingual language processing and multilingual learning. Although cross-training involves many phenomena beyond learning single words, focusing on existing models that have been developed solely on the basis of the bilingual case provides a starting point for understanding the nature of language learning and processing during multilingual cross-training.

Most models of the multilingual mind have been developed with a specific focus on individuals who know two languages. In contrast, the Dynamic Multilingual Model (e.g., Herdina & Jessner, 2002) is the only model developed specifically to consider how a linguistic system changes in the presence of three or more languages. This model espouses the assumptions of chaos theory, claiming that the linguistic system is forever in an unpredictable state of change (language gain, sustainment, or attrition) that is influenced by changes to any of the languages in the system. Although this model provides an important and appropriate acknowledgement of the complexities of the multilingual mind, it unfortunately fails to provide a theoretical framework from which hypotheses and testable predictions can be generated regarding the nature of multilingual language processing. Therefore, we turn our attention instead to models that are more highly specified, although not necessarily designed specifically to address multilingual issues.

In a few instances, theorists have considered how to extend existing models of bilingualism to the multilingual case. For example, Dijkstra (2003) discussed the ability of the Bilingual Interactive Activation (BIA+) model to include a third language and concluded that such extensions can easily be accommodated within the BIA+’s existing mechanisms. In the current BIA+ model, language membership is represented via language nodes, or “tags” that are attached to the orthographic representations of words. Words from an L3
could be represented by linking an L3 language node to the L3 orthographic representations. As in the bilingual case, trilingual word identification would proceed by virtue of the facilitatory and inhibitory connections across and within the sublexical (i.e., letter) and lexical (i.e., word) levels of the model. Dijkstra reported results of simulations suggesting that the system does not experience catastrophic interference when a third language is introduced, but rather the three languages can coexist by virtue of these mechanisms already in place within the BIA+. Therefore, according to Dijkstra, considering multilinguals does not require any explicit changes to the model's architecture or mechanisms, nor does the multilingual BIA+ make any predictions not already established in the bilingual case. The BIA+ simulations demonstrate that the same mechanisms and processing factors that affect bilingual word recognition apply to the multilingual, suggesting that the BIA+ can provide insights into the cross-training situation with respect to factors affecting when facilitation or interference is likely to be experienced.

As with the BIA+, other models of bilingual language processing may be able to accommodate multiple languages, although in some cases it may be necessary to make certain adjustments to the existing architecture or processing mechanisms. Below, we consider two prominent bilingual models: the Revised Hierarchical Model (RHM; e.g., Kroll & Stewart, 1994) and the Inhibitory Control (IC) model (e.g., Green, 1998). As will be seen in the following section, in some cases, considering multilingual extensions of existing models may, in fact, lead to unique predictions and further insights into the fundamental mechanisms underlying multilingualism. We focus on the RHM and the IC Model because these two examples provide an interesting contrast in the necessity to modify the model to accommodate multilingual phenomena. Specifically, the fundamental assumptions of the RHM appear to successfully account for the phenomena documented in the relevant trilingual language processing studies reviewed below, whereas results from trilingual language switching studies suggest that the mechanisms of the IC Model may require further specification regarding the precise nature of inhibition. We return to this point below.

Revised Hierarchical Model

The RHM (Kroll & Stewart, 1994) addresses the nature of the connections among a bilingual’s L1 lexical representations, L2 lexical representations, and conceptual representations. The model posits separate lexicons for the two languages, both of which access a common conceptual store. The model is developmental in that the relative strengths of various connections are believed to change as a bilingual gains proficiency in the L2. At early stages of L2 acquisition, the learner develops direct lexical connections between new L2 words and their L1 counterparts, but L2 words typically are not strongly linked to concepts. With increasing proficiency, the bilingual develops stronger lexico-semantic connections between the L2 lexical items and their corresponding conceptual representations. One potential exception to this pattern may be for concepts learned in the L2 that do not have an L1 counterpart, for which a direct lexical-semantic connection may be formed at initial stages of learning (see Pavlenko, 2009).

The RHM could be extended to the multilingual case by simply adding additional language-specific lexicons for the L3, along with the corresponding interlingual lexical connections (e.g., between L2-L3 translation pairs) and lexico-semantic connections. There is already empirical evidence to support such an extension. Abunuwara (1992) compared picture naming and word naming in trilinguals. Similar to proficiency-related, between-subjects differences found with bilinguals in other studies (e.g., Talamas, Kroll, & Dufour, 1999), he found that the more dominant non-native language demonstrated greater conceptual mediation, whereas the less dominant language showed more lexical mediation. De Groot and Hoeks (1995) examined forward translation (from the L1) and translation recognition in trilinguals. They included in their materials a concreteness manipulation, which has been shown to affect semantic processing (i.e., participants are faster to recognize or translate concrete words relative to abstract words). In translation production, clear concreteness effects were found during L1-L2 translation but not during L1-L3 translation; less robust effects were found in translation recognition, but the same general pattern was found. The results suggest that the relative proficiency of the non-native language impacts the extent to which lexical access is lexically or conceptually mediated, as evidenced within the same participants by studying trilinguals with differing proficiency in L2 and L3. Taken together, these results indicate that the developmental predictions of the RHM hold with multilinguals and suggest that the architecture can easily be expanded to accommodate multiple languages. Because it models the development of lexical representations in the bilingual/multilingual mind, the RHM provides an important
framework for understanding the process of vocabulary learning that potentially can inform methods for enhancing vocabulary knowledge.

**Inhibitory Control (IC) Model**

Whereas the RHM describes the connections between words and mental concepts in a bilingual’s two languages, the IC Model (Green, 1998) is concerned with the mechanisms that support a bilingual’s access to and use of two languages. The IC Model posits that all language tasks require a bilingual to inhibit the language that is not needed in order to function in the other language. For example, naming pictures in an L2 would require inhibition of the L1 lexicon so as not to inadvertently produce words in the non-target language. The model further proposes that the amount of effort required to inhibit a language is dependent in part on the individual’s level of proficiency in that language; thus for an unbalanced bilingual it would be much more difficult to inhibit L1 than to inhibit the relatively weaker L2.

Although Green (1998) originally hypothesized that inhibition occurs at the level of the lemma – an abstract mental representation of a word rather than the physical representation of its sound or written form – subsequent research has attempted to test this hypothesis and more precisely pinpoint what aspects of the bilingual language system might be subject to inhibition. A common approach to addressing this question has been to conduct experiments involving language switching during cognitive tasks. In these tasks, participants are presented a series of stimuli (e.g., pictures) paired with a visual cue (e.g., colored background) that indicates the language in which they must name the stimulus on the current trial. Picture naming is a commonly used task because it requires participants to use conceptual information to retrieve and produce a word, thus shedding light on the factors that affect lexical retrieval. On some trials, the language of naming is repeated from the previous trial (a non-switch trial), whereas on other trials the language of naming is different from the previous trial (a switch trial). A number of studies have found that bilingual participants are slower to name pictures on switch trials relative to non-switch trials – a phenomenon termed “switch costs” – and, counterintuitively, that switch costs are larger when switching into one’s dominant L1 than when switching into the less dominant L2 (e.g., Meuter & Allport, 1999). This pattern of switch costs has been argued to reflect inhibition of the non-target language on the previous trial that carries over to the next trial. In other words, naming a picture in L2 requires inhibition of L1, which then carries over to the next trial and makes it difficult to switch to naming a picture in L1.

To examine the nature of this hypothesized inhibition during language switching, Philipp and Koch (2009) included two separate cues for each language (e.g., L1 = red background or triangle surrounding picture) and two response sets (digits and color names) within each language. They then manipulated the repetition of the language cues (Experiment 1) and the specific response sets (e.g., Experiment 2) to examine whether inhibition during language switching operates at the level of specific language cues, specific stimulus-response sets, or more globally across the entire language. They found that evidence of inhibition did not depend on the repetition of a language cue or a specific stimulus-response set (cf. Finkbeiner, Almeida, Janssen, & Caramazza, 2006). These results were interpreted to suggest that inhibition during language switching operates across the entire abandoned language rather than being driven by specific language cues or repetition of stimulus-response sets.

In the context of experiments on trilingual language switching, Linck, Schwieter, and Sunderman (2012) discussed how Green's (1998) Inhibitory Control model could be extended to the trilingual case. One possibility is a language-specific inhibitory model, by which task schemas inhibit each language separately. For example, when naming pictures in the L3, the L3 naming schema would induce inhibition of the L1 and the L2, and would likely require greater inhibition of the L1. In contrast, a more general account would posit that the inhibition is applied across any representation not associated with the current target language, without any distinction between the non-target languages. So when naming in the L3, inhibition would be applied to any L1 or L2 representation. If we assume that the task schema can be activated to different levels, then we might expect to see greater differences in inhibition applied to L1 representations in the former case vs. the latter case, as the language-specific inhibition account could allow the system to be biased towards inhibiting the more dominant L1 to support speaking in the non-dominant languages. The results from Linck et al.’s trilingual switching study supported the language-specific inhibition account: they found that better inhibitors showed reduced language switching costs, but only when switching into or out of the L1. This result suggests that inhibition was being applied to each language individually, indicating nuanced processing dynamics for multilingual language control.
It will be important for future research to design experiments to contrast these different theoretical positions with multilingual participants in order to further elucidate how and when inhibitory control supports multilingual speech production. This line of research could suggest the design of particular pedagogical approaches that encourage inhibitory processing during L3 learning or that leverage learners’ inhibitory control abilities to enhance the learning process.

Evidence of multilingual transfer

A critical observation in the literature on multilingualism is that individuals can experience both facilitation (i.e., positive transfer) and interference (i.e., negative transfer) between their languages across a range of tasks and contexts. In this section, we review available evidence of such facilitation and interference during multilingual language processing. In the next section, we then consider some of the factors that might influence when transfer does or does not occur, as these factors may inform pedagogical approaches to multilingual instruction.

There is evidence that cognates – words that overlap across languages in their written form, sounds, and meaning – are recognized, understood, and produced more easily than non-cognates. Lemhofer, Dijkstra, and Michel (2004) asked Dutch-English-German trilinguals to perform a lexical-decision task. In this task, participants are shown a letter string (e.g., cat) and are instructed to indicate with a button press whether the presented string forms a word. The outcome measure of interest is usually the speed of making a correct response, which provides information on the participant’s vocabulary knowledge and ability to recognize individual words quickly. Moreover, different types of words (e.g., cat) and non-words (e.g., blart) can be included to assess different aspects or features of word recognition, such as the degree to which the task is affected by similarity across languages. In their study, Lemhofer and colleagues instructed participants to indicate whether the letter string formed a word specifically in the L3, which was German. To assess the degree of cross-language activation during this task, they included in their word list two types of cognates: double cognates, in which word forms and sounds were shared between the L1 and L3, but not the L2 (e.g., kunst, Dutch and German for art), and triple cognates, in which word forms and sounds overlapped in all three languages (e.g., echo). They found cognate facilitation for both types of cognates, with greater facilitation for the triple cognates than the double cognates, suggesting that the greater amount of overlapping information across all three languages offered even more benefits to processing. Van Hell and Dijkstra (2002) found trilingual cognate facilitation even when performing the lexical decision in the dominant L1. Participants included Dutch-English-French trilinguals who all had relatively high proficiency in the L2 but varied in their L3 proficiency (either low or medium). Clear cognate facilitation effects were found for both proficiency groups when responding to L1-L2 cognates. However, cognate facilitation effects for L1-L3 cognates were only found for the participants with higher L3 proficiency, suggesting that a minimum degree of proficiency in the L3 was required for the cognates to be activated sufficiently (or rapidly enough) to impact their judgments of the words in the dominant L1. Multilingual cognate facilitation has also been found during L3-L1 translation by Russian-English-Swedish trilinguals in a study including L1-L3, L2-L3, and L1-L2-L3 cognates (Tkachenko, 2001).

Word retrieval is an important aspect of L3 learning and use. Lexical decision tasks provide a sensitive measure of word retrieval and can demonstrate (sometimes subtle) effects of various factors that may impact word learning and fluent L3 use. As such, the information from lexical decision tasks can inform multilingual pedagogy by making instructors and students aware of the types of factors that may impact learning. For example, the studies above demonstrating L1 and L2 cognate effects on L3 lexical processing lend empirical support to the long-held pedagogical technique of focusing on cognates at early stages of learning, as learners can rely on their more established L1 and L2 knowledge to bootstrap into the L3. Therefore, the results of studies employing the lexical decision task might inform the development of vocabulary lists at various stages of L3 learning.

These facilitative effects are not simply restricted to highly overlapping word forms such as cognates. In fact, there is evidence that cross-language interactions in multilinguals can lead to semantic priming from an entirely task-irrelevant language (i.e., a language not being accessed at the moment). Semantic priming refers to the finding that the often brief exposure to one stimulus (the prime) can influence the processing of another stimulus (the target) when the two are semantically related to one another. This finding can occur even if the prime is followed by a string of characters, or mask, such as “####” that makes the stimulus difficult (if not impossible)
to consciously perceive. For example, during a lexical decision task, briefly flashing the word bread followed by toast typically speeds correct ‘yes’ lexical decisions to the word toast. This type of effect is referred to as semantic masked priming.

Using a variation of the semantic masked priming paradigm, Duyck, Depestel, Fias, and Reynvoet (2008) examined numerical distance effects as a measure of semantic processing during L1-L3 translation. They presented Dutch-English-French trilinguals with numerical words (i.e., the numbers one through nine) in either the L1 or L3, with masked primes of the L2 numerical words that varied in their numerical distance from the target number. Previous studies have found that primes that are numerically close to the target word (e.g., prime = four, target = five) show larger priming effects than primes that are numerically further from the target (e.g., prime = three, target = five). This numerical distance effect has been interpreted to suggest that the participants are accessing the semantic meaning of both the primes and the targets. Duyck et al. found that the trilinguals showed numerical distance effects in both directions of translation, indicating that activation of the non-target, task-irrelevant L2 (the masked prime) impacted processing at the semantic level when producing in both the less dominant L3 and the dominant L1. Note that the task was designed to never require L2 access (i.e., naming and translation only involved the L1 and L3), demonstrating further that multilingual effects can emerge even when in a purely "bilingual" context or mode. These results indicate that the L1 and L2 will always be active to some degree within the multilingual classroom, suggesting that efforts to completely ignore the L1 and L2 may be futile. Rather than avoiding the L1 or L2, it may be more beneficial to openly employ these languages where they can be useful in order to encourage positive transfer during L3 instruction.

Cross-language interactions can also lead to interference that has deleterious effects on performance in the target language. These negative transfer effects have been documented in trilinguals in several studies using cross-language Stroop paradigms (e.g., Abunuwara, 1992; Marian, Blumenfeld, Mizrahi, Kanie, & Corder, 2013). In the Stroop task, a word that is the name of a color is presented in a colored font that is either congruent or incongruent with the meaning of the word (e.g., congruent = red in red font; incongruent = red in blue font), and participants are asked to say the name of the font color while ignoring the word. Correct responses are typically slower on incongruent than on congruent trials, and this difference is referred to as the Stroop effect (e.g., Stroop, 1935). The Stroop effect is assumed to reflect a need to inhibit or suppress the overlearned tendency to read a string of letters, rather than simply identifying the color of the font. In Abunuwara's study, trilinguals showed interlingual Stroop effects in all combinations of response and distractor language pairings – that is, when naming the font color in one language, a Stroop effect was found even when the color word was presented in a different language. Abunuwara reported interesting asymmetries in the magnitude of the Stroop effects, a point to which we will return below when discussing factors that impact cross-language effects. Taken together, these results suggest that even when naming in the dominant L1, a multilingual's other languages may interfere with speech production. With respect to multilingual instruction, these results further highlight the importance of considering how both positive and negative transfer among all known languages can impact learning and language use within the multilingual instructional setting.

To examine the use of function words (conjunctions, determiners, prepositions, or pronouns) during multilingual written production, De Angelis (2005) asked multilingual learners of Italian whose previously known languages included English, Spanish, and/or French to first read a passage in their L1, then write a summary of the passage in their L3. The results indicated that learners transferred function words from L1 or L2 during L3 written production. However, interesting differences were found based on the combination of known languages, such that greater transfer of L2 function words was found among learners for whom L2 was more typologically similar to the L3; that is, greater L2-L3 similarity was related to greater L2 transfer. The transfer effects were sometimes positive and sometimes negative, depending, in part, on the featural overlap between the languages in question. These findings suggest that one cannot make an across-the-board prediction regarding the nature of transfer without also taking into consideration the specific languages and features known by the multilingual learner.

In a study examining processing of adjective placement by trilinguals, Rothman (2011) asked participants who knew English in addition to two Romance languages to complete two sentence processing tasks. In the Semantic Interpretation task, participants first read a short sentence containing an adjective phrase, and then indicated which of two descriptions properly captured the meaning of the sentence. In the context-based collocation task, participants read a short story that contained a number of nouns both preceded and followed by a blank line.
Participants were instructed to fill in the appropriate blank with the adjective that followed in parentheses (e.g., “Magda es una _____ amiga ____ (viejo).”). This design took advantage of the fact that the placement of an adjective either before or after a noun alters the nuances of interpretation of the noun phrase, whereas this variation does not exist in English. Participants tested at near-native proficiency in their L2 and intermediate proficiency in the L3. No differences in response accuracy were found between the trilingual groups and a monolingual control group, which Rothman concluded provided evidence that L3 transfer had occurred. That is, the trilingual participants had completed the tasks with native-like grammar for this specific adjective placement property, suggesting that positive transfer had benefited their L3 knowledge. However, it is worth noting that the author's conclusions were based on a pair of null results (main effect of group, and group by condition interaction) obtained with a research design involving only five observations per participant in each condition, leaving the strength of the inferences somewhat in question. Given these weaknesses, further replication is needed with independent samples before any conclusive inferences are drawn from these results.

As demonstrated by the findings described above, a multilingual's L1 and L2 knowledge can impact L3 learning and processing, and this transfer can either benefit the learner (i.e., positive transfer) or somehow interfere with learning or using the L3 (i.e., negative transfer). There is some suggestion that the specific languages in consideration can limit or affect the types of transfer effects – a point that we consider below (see (Psycho)typological similarity). These results suggest that any pedagogical techniques that can increase positive transfer and reduce negative transfer will benefit the multilingual learner.

Factors that affect cross-language interactions

To understand more fully the nature of cross-linguistic interaction, it is important to examine not only what types of transfer effects occur, but under what circumstances. In this section we review the literature on a number of factors that appear to constrain or inform when cross-linguistic interactions will impact language processing or learning.

Relative proficiency

One of the strongest factors affecting cross-language transfer appears to be the relative proficiency across all known languages – not just the L3. That is, it is not simply the degree of proficiency in the L3 that matters, nor the L2; rather, all languages contribute to the linguistic profile of the language user and have the potential to impact performance or learning. Rah (2010) also points out that classification of learned languages as L2 vs. L3 is not necessarily straightforward; the earlier learned language is not always better known than the later learned language, and transfer effects can be affected by both relative order and relative proficiency. Evidence of the impact of relative proficiency comes from a range of tasks demonstrating a breadth of both facilitation (positive transfer) and interference (negative transfer) effects.

**Cognate facilitation.** In the Van Hell and Dijkstra (2002) study mentioned above, L1 lexical decisions were facilitated by L3 cognates, but only for the more proficient participants. In Tkachenko’s (2001) study involving L3-L1 translation, participants were trilinguals who had a high level of proficiency in their L2 but varied in their L3 proficiency. Although the sample size in each group was fairly small (10 beginner, 10 intermediate, and 6 advanced L3 learners), the results suggest that overall cognate facilitation was smallest for the most proficient L3 learners. While the findings from these two studies may seem contradictory, it is important to note that in Van Hell and Dijkstra, participants were completing the lexical-decision task entirely in their L1, and we would not expect processing in a strong L1 to be significantly affected by a relatively weak L3. In the study by Tkachenko, on the other hand, the translation task required processing of the L3, and thus individuals with lower L3 proficiency benefited more from overlap with their other, stronger languages.

**Switch costs.** Linck et al. (2012) examined the performance of a language switching task with English-French-Spanish trilinguals who were L1 dominant and were more proficient in their L2 than in their L3. Participants were presented a series of pictures and were instructed to name each picture in the L1, L2 or L3, as cued by the colored background of the picture. Linck et al. (2012) also found that switch costs differed as a function of proficiency, with the greatest costs being for switches into the L1 and the smallest costs being for switches into the L3. Using a similar sample of English-French-Spanish trilinguals, Schwieter and Sunderman (2011) examined the relationship between language switching performance and individual differences in lexical
robustness (i.e., vocabulary size). Greater L2 lexical robustness was associated with faster picture naming in both the L2 and the L3, suggesting that learners who are able to develop a deeper vocabulary in the first non-native language are perhaps better at accessing their L2 and L3 lexicons, and therefore are faster overall on a mixed language task. Interestingly, larger L3 lexical robustness was only related to smaller switch costs into the L3 – suggesting a more constrained impact of the L3 lexicon on the L2 when switching between languages.

Costa and colleagues (e.g., Costa & Santesteban, 2004; Costa, Santesteban, & Ivanova, 2006) have argued that one key component of the proficiency factor is whether individuals have achieved “balanced” bilingualism in at least two languages (i.e., they have attained high-level proficiency in an L2). Once such a state has been achieved, it is argued that these multilinguals have developed the ability to control cognitive attention such that lexical items can be selected via a language-specific mechanism whereby lexical candidates in the non-target language may also become activated along with the target language but do not compete for selection, i.e., they do not influence the process of lexical access. In other words, Costa and colleagues argue for a qualitative shift in how cross-linguistic activation is managed by the multilingual mind once a certain level of proficiency is attained in a non-L1. It is important to note that the results reported by Costa and colleagues come from studies involving childhood bilinguals. Nonetheless, it is plausible that their claims regarding the shift away from the need to rely on inhibitory control could also be found with adult learners who achieve high-level proficiency in an L2. This area is ripe for future research, as the results have implications for theories of bilingual control (and its development) as well as for our understanding of whether age of acquisition constrains when or how general cognitive control mechanisms support multilingual processing. Furthermore, findings from such research could inform pedagogy by determining the optimal time within the learning trajectory to implement language training methods (discussed above) aimed at encouraging inhibitory processing or leveraging an individual’s inhibitory control abilities.

The results of bilingual/multilingual language switching studies have been interpreted most frequently in the context of the discussion of the potential role of inhibition in multilingual speech production. Although switch costs per se may not provide the most conclusive inferences regarding the role of inhibition during speech production (see Kroll et al., 2006), studies by Philipp and colleagues demonstrate how examining language switching with multilinguals provides opportunities to test hypotheses regarding the underlying (inhibitory) mechanisms in ways that are unavailable in studies of bilingual participants. For example, Philipp, Gade and Koch (2007) designed a language switching task similar to the picture naming task employed by Linck et al. (2012), but with the additional sequential manipulation that the language used on trial n and trial n-2 either repeated or did not repeat, and the intervening trial (n-1) involved a third language. They found that language repetitions were associated with slower responses than language non-repetitions (so-called n-2 repetition costs), indicating that inhibition of the previously abandoned language persisted to trial n. This repetition cost was largest for the dominant L1, indicating that relative proficiency modulated the inhibitory effects. Curiously, the repetition effect was larger in the least dominant L3 than in the L2, a finding that does not completely fit with the dominance-based predictions of the IC Model. Jointly examining switch costs and n-2 repetition costs offers opportunities to further explore the nature of control mechanisms during language switching. Further replication of Philipp et al.’s results with other samples – and with other language sets – is needed to provide additional, much needed evidence of the contributions of inhibitory control to multilingual language switching. We consider potential implications of this line of research for multilingual pedagogy below in the context of the broader literature on cognitive control and executive functions.

**Stroop effects.** As mentioned above, cross-language interference has been demonstrated in the Stroop task. However, the patterns of interference depend in part on the relative proficiency of the multilinguals’ languages. For example, Abunuwara (1992) found interlingual Stroop effects in all three languages of Arabic-Hebrew-English trilinguals, with differing patterns across the three languages. The L1 interference effects were larger when naming in the L3 than when naming in the L2, which is congruent with dominance accounts of cross-language interference (e.g., the IC Model) that predict a less dominant L3 will suffer more L1 interference than a more dominant L2 because of the greater asymmetry in language dominance. However, during L1 naming, interference was greater from L2 words than from L3 words, indicating that the more proficient L2 was interfering more with lexical access of the dominant L1, a finding that is also congruent with dominance accounts of cross-language interference. Interestingly, the L2 and L3 interfered little with each other. This finding goes counter to the predictions of the “L2 status” factor or “foreign language effect” (e.g., Bardel & Falk,
2007), which suggests that during L3 learning, the L2 is more likely than the L1 to transfer to the L3 due to its status of being a foreign language. Arguments based on the L2 status factor would posit that L3 naming should show greater interference from the (non-native) L2 than from the L1. Indeed, as will be discussed further in the section on (psycho)typological similarity below, the currently available evidence does not seem to support this claim.

**Phonological and grammatical processing.** As noted above, when considering the L3 in particular, there is some evidence that the amount of cross-language interaction changes as a function of the degree of proficiency in the L3. Focusing on phonological processing, there is some evidence that a less proficient L3 tends to be affected by the L2 substantially, whereas this L2-on-L3 influence attenuates as the L3 becomes more proficient. Hammarberg and Hammarberg (1993, 2005) examined the L3 Swedish speech of an English/German speaker at two points in time, focusing on the articulation of a number of different segments (e.g., the relative positioning of the tongue during the articulation of /l/) to determine whether the L3 speech was more heavily influenced by L1 or L2. They concluded that in early learning, the speaker used her L2 articulatory settings in order to suppress L1 influence. In later learning, the L2 effects attenuated, thereby allowing the L1 to influence L3 speech. For grammatical processing, Peyer, Kaiser, and Berthele (2010) showed that as L3 proficiency increases, the relative asymmetry in proficiency with other languages seems to matter less, presumably because the L3 is developing stronger lexical representations and more direct access to the grammar. Evaluating the reading comprehension performance of French/English and Spanish/English speaking students of German, they found that students with high German proficiency performed equally well regardless of their reading comprehension in their other languages. Learners with low L3 proficiency, however, performed better if their proficiency in other languages was also high, suggesting that competency in one or more foreign languages enhances performance in another. Taken together with the results reviewed above, these studies indicate that relative proficiency affects cross-language interactions across many levels, from lexical access to semantic and syntactic processing to articulation of the phonology.

Taken together, the patterns of results reviewed here indicate that the relative proficiency of all of one’s known languages will impact language processing and language learning in a new L3. This suggests that a learner’s language profile provides important information that can inform decisions about how to cross-train into an L3.

**Cognitive control/Executive functions**

Another important factor affecting the presence or absence of transfer effects is the individual learner’s cognitive control abilities, otherwise known as ‘executive functions’ or ‘executive control.’ Executive functions refer to the cognitive processes that support the performance of complex tasks by maintaining attentional focus in the presence of distracting information and by managing conflict (e.g., Engle, 2002). For example, executive control allows one to selectively attend to a friend or colleague during a conversation at a party where there are many other distracting conversations happening in the background. There is growing evidence that executive functions are called upon to support L2 use (e.g., Abutalebi & Green, 2007; Hernandez & Meschyan, 2006), in part to help negotiate the potential cross-language interference from the L1. This evidence suggests that executive control may be especially important in multilingual language processing because there are more opportunities for negative transfer to occur between languages. Indeed, although the empirical data currently are sparse, there is encouraging evidence of the impact of executive functions on multilingual processing. We review the few extant studies below, then we consider implications for multilingual instruction.

Linck et al. (2012) found not only that trilingual switch costs varied according to the relative proficiency of the three languages, but also that the magnitude of the switch costs was related to individual differences in inhibitory control abilities, with better inhibitors showing reduced switch costs when switching into or out of the dominant L1. By their account, better inhibitors may be capable of more efficiently applying inhibition to non-target representations in the L1 when naming targets in the other languages, such that less inhibition is required to successfully speak in the L2 or L3. That is, the spike in activation of the non-target L1 can be attenuated sooner (i.e., at lower levels of activation), and thus a smaller amount of inhibition is required to prevent the L1 from intruding on the target language. The fact that the inhibitory control effects were restricted to conditions involving the L1 indicates that relative proficiency also plays a role, which suggests that individual differences
in inhibitory control – and perhaps executive functions more generally – also contribute to the complicated situation of multilinguals managing cross-language interactions.

A related line of research has found that bilingualism appears to incur more general cognitive benefits to one’s ability to manage interference from conflicting information (for reviews, see Bialystok, 2010; Bialystok, Craik, Green, & Gollan, 2009). That is, a lifetime of experience managing and successfully using two languages may enhance a bilingual’s executive control abilities. Both behavioral and neuroimaging studies suggest that bilingualism enhances one’s cognitive reserve – i.e., the maintenance of cognitive functioning in the face of age-related declines (e.g., Schweizer, Ware, Fischer, Craik, & Bialystok, 2012). This line of research raises the question of whether these cognitive consequences are further enhanced as the number of mastered languages increases. There is some evidence suggesting this may be the case. Kave, Eyal, Shorek, and Cohen-Mansfield (2008) tested aging adults in their 80s with two standardized tests of attention and memory (e.g., Mini Mental State Exam) and retested them into their 90s to examine how linguistic experiences were related to age-related cognitive decline. They found that multilingualism was related to enhanced cognitive reserve as evidenced by superior cognitive functioning in multilinguals relative to monolinguals; moreover, an examination of the multilinguals suggests that as the number of mastered languages increased, so too did the extent of the enhancements to cognitive reserve. These results suggest that attaining proficiency in additional languages beyond an L2 may provide opportunities to further strengthen one’s cognitive control mechanisms that support multilingual language use. However, additional research is needed to elucidate the precise relationship between quantitative and qualitative characteristics of the multilingual experience and enhanced cognitive control.

(Psycho)typological similarity

Research from the fields of linguistics and applied psycholinguistics indicates that languages with greater typological similarity tend to demonstrate more cross-language interactions that can result in both positive and negative transfer. The body of research from the field of linguistics has generated discussions on one of the most widely recognized constraints on transfer – the degree of congruence among all involved languages – leading to the concepts of “cross-linguistic similarity” and “cross-linguistic difference.” These two concepts have been often further divided into objective and subjective similarities (or differences). In the relevant literature, objective similarity (or difference) refers to the actual degree of congruence that exists between the languages on measureable features, whereas subjective similarity refers to the degree of congruence that the learner either perceives or assumes to exist (Jarvis & Pavlenko, 2010). In general, the subjective similarities (or differences) have been considered as essential for transfer to occur because it is the learner’s awareness of those similarities that determines which features of one language are transferable to the other (Kellerman, 1978, 1983). Two types of subjective similarities – perceived and assumed – have been described in the literature, and they are not always mutually exclusive (Jarvis, 1998; Ringbom, 2007). According to these researchers, a perceived similarity is a learner’s judgment, either conscious or unconscious, that a given feature of the languages is similar. An assumed similarity refers to a learner’s hypothesis that a given feature of one language exists in the other language. These distinctions might be helpful in explaining instances of positive and negative transfer, as Jarvis and Pavlenko (2010) argue that “positive transfer occurs when assumed similarities are compatible with objective similarities, whereas negative transfer occurs when assumed similarities conflict with objective differences” (p. 182). These results suggest that multilingual instruction could benefit from efforts to explicitly draw the learner’s attention to any known or potential conflicts between observed and perceived similarities in order to reduce negative transfer and increase positive transfer. We return to this point in the third section on language pedagogy.

The body of research from the field of applied psycholinguistics has motivated the development of three somewhat contradictory accounts of transfer. According to the Cumulative Enhancement Model (e.g., Flynn, Foley, & Vinruitsika, 2004), all previously-learned languages can be drawn upon in subsequent language learning. In contrast, other researchers have claimed that the “L2 status” factor is the most critical factor, such that transfer is more likely to come from the L2 than the native L1 (e.g., Bardel & Falk, 2007). However, Rothman (2010) argued that neither of these accounts is fully able to capture the extant results. Instead, Rothman claimed that psychotypological similarity (i.e., perceived similarity) trumps the L2 status factor when they are pitted against one another. In his study of adjective placement, Rothman examined two groups of trilinguals: English-Portuguese-Spanish speakers, whose L1 lacked the adjective placement flexibility
manipulated in the materials, and Italian-English-Spanish speakers, whose L1 allowed such flexibility in adjective placement. Rothman reasoned that if L2 status is the key factor, then we would expect to see transfer on the adjective processing task for the native English speakers but not the Spanish-English-Portuguese trilinguals; if instead psychotypological similarity drives transfer, then both groups should show transfer effects. Indeed, both groups were indistinguishable from monolinguals, suggesting that psychotypological similarly trumped L2 status (but see comments above regarding the methodological and inferential limitations of this study).

For phonological processing, Llama, Cardoso, and Collins (2010) argue that L2 status has more influence on transfer than does typological similarity, but that ultimately, L3 phonological output is likely a function of combined cross-language interference (De Angelis, 2007). In a study of English/French and French/English bilinguals learning Spanish, they found that both groups of learners behaved similarly in their production of Spanish stops with respect to voice onset time (VOT). If typological similarity were the bigger influence on L3 pronunciation, native French speakers should have had an advantage in producing native-like Spanish aspiration, which is almost identical to French aspiration. Instead, the native French speakers in the study seem to have resorted to VOTs more similar to their non-native English values. However, the authors concede that they relied on averages from the literature to estimate native VOT values for both groups, as well as expected target ranges for Spanish. Because VOT can be highly variable across speaker populations, and the range of averages for French, English, and Spanish all overlap, it is difficult to confidently conclude that L2 status really trumps psychotypological similarity.

**Age of acquisition/exposure**

There is a rich literature examining age of acquisition effects in L2 learning (for a brief overview and additional references, see DeKeyser, 2013). The general pattern suggests that childhood learning tends to result in a higher likelihood of attaining substantial proficiency in the L2, whereas adult learning tends to be much less successful. For the current discussion, we largely focus on adult learners of an L3, although we do consider the impact of age of acquisition on some specific factors below (e.g., inhibitory control). Nonetheless, when considering factors that influence multilingual learning, one must take into account the learner's linguistic profile and prior learning experiences. Indeed, aside from age of acquisition per se, a number of other factors impacting L3 learning indicate that the learner's previous experience with language has a strong effect on L3 learning. We turn to those factors in the next section.

It is worth noting that heritage speakers represent a unique type of bilingual (e.g., Montrul, 2010), facing specific issues by virtue of not necessarily having a formalized understanding of the grammar of their L1, and, in some cases, lacking literacy entirely. This situation raises a number of questions regarding when and how L1 transfer will interact with L2 transfer to affect L3 learning. Further work focusing on heritage learners of an L3 is needed to better understand whether the factors identified above apply to their learning situation as well. This is a clear gap in the literature.

**Type of task**

In light of the number of factors shown to influence language transfer in L3 learning, it is important to consider that a research design itself may inadvertently favor some types of interference. For instance, Hammarberg and Hammarberg’s (1993) case study of an English/German learner of Swedish clearly showed that language influence is task dependent. Their learner evidenced more interference from L1 phonology in a read-on-your-own task and more L2 transfer in a picture narration task and a read-after-me task, in which the speaker shadowed the pronunciation of a native Swedish speaker. The authors note that the speaker explicitly expressed a desire to suppress any English accent on her Swedish speech. When faced with speaking freely or reading without a model, she was able to rely more on her L2 phonological knowledge to fill in the gaps in her Swedish pronunciation. When mimicking native speech, however, she was not as successful at suppressing her L1 influence. These results further complicate the research landscape by suggesting that learners may be able to consciously control some of the effects of language transfer, at least in some situations or when performing certain tasks. More research is needed to further elucidate how the type of task impacts positive and negative
transfer. This line of research could inform the selection of learning tasks that are well suited to facilitating positive transfer and reducing negative transfer in a cross-training situation.

MULTILINGUAL LEARNING

In addition to examining factors that influence multilingual language processing, it is important to consider how these (and other) factors might influence the language learning process. A small number of studies have explicitly examined vocabulary learning by multilinguals. Given that one needs to learn words in a new language to be able to communicate in that language, understanding the process of vocabulary learning provides an understanding of a central facet of language acquisition. Below, we review the extant studies on vocabulary learning within the multilingual context. Although these studies examine various conditions under which bilinguals may exhibit advantages in vocabulary learning, they do not address the mechanism(s) that may lead to that advantage. To begin exploring the mechanism question, we briefly review the state of the existing literature on metalinguistic awareness as a potentially important factor in the multilingual learning process.

Vocabulary learning

There is a growing literature examining bilingual advantages in L3 learning, with many of the studies focusing on vocabulary learning. For example, Kaushanskaya and Marian (2009) compared monolingual English speakers to a group of bilinguals whose two languages share the same script (early English-Spanish bilinguals) and a group of bilinguals whose two languages use different writing systems (early English-Mandarin bilinguals). Participants came into the lab to perform a novel word-learning task involving an artificial phonological system. In the initial learning phase, participants were taught 48 disyllabic novel foreign language words; participants first heard each word over headphones while its English translation was presented on the computer screen, after which they were instructed to produce the word and its translation aloud. To assess learning, participants completed tests of recognition and recall both immediately and after a 1-week delay. Results for the immediate recall test indicated that both bilingual groups correctly recalled nearly half of the new words, whereas the monolinguals recalled only about 25%. The bilingual groups also outperformed the monolinguals on the delayed recall test and on both immediate and delayed recognition tests, with no differences between same-script and different-script bilinguals in their overall performance.

Similar patterns of bilingual advantages have been found with native Italian speakers learning Russian as an L3 (Papagno & Vallar, 1995) and native Dutch speakers learning Spanish (Van Hell & Mahn, 1997). However, an important point to note is that all these studies employed a research design in which the language of instruction for the novel words was always the L1. Given that both the L1 and L2 can transfer during L3 learning, it is possible that learning would be further enhanced by instruction in the L3. To examine whether learning would be affected by the language of instruction, Bogulski (2009) designed an experiment in which Dutch words were learned via their English translations. She compared the performance of two bilingual groups: English-Spanish bilinguals (instruction in L1), and Mandarin-English bilinguals (instruction in L2). On an immediate test of translation recognition, the English-Spanish bilinguals were both faster and more accurate than the Chinese-English bilinguals (78.1% vs. 70.7% accuracy, respectively), indicating that learning via the L1 enhanced performance. However, a different picture emerged on a delayed post-training lexical decision task, on which both bilingual groups performed similarly and outperformed a group of monolingual English speakers, indicating a bilingual advantage on retention of the newly learned vocabulary, regardless of the language of instruction. One possible explanation of these differences relates to the languages involved in the tasks. The translation recognition task materials involved Dutch-English word pairs, such that the Chinese-English bilinguals were performing the task in their L2 and L3 whereas the English-Spanish bilinguals were performing it in their L1 and L3. This involvement of the less automatized L2 for the Chinese-English bilinguals may have impaired their performance on the translation recognition task, leading to lower accuracy relative to the English-Spanish bilinguals. In contrast, the lexical decision task simply involved making judgments of whether a word string was a word in Dutch without any explicit requirement to use English. By eliminating the need to use the L2, this task may have allowed the Chinese-English bilinguals to perform at a higher level. Taken together,
these results suggest that bilinguals may bring language learning skills to the experience of learning a new L3, which can enhance the learning process.

Taken together, the results of laboratory studies on novel vocabulary learning indicate that prior L2 experience benefits the learning of vocabulary in a new language. Although the study by Bogulski (2009) suggests a short-lived effect of the language of instruction (i.e., learning via the L1 vs. the L2) on L3 word learning, the question remains of whether (perceived) similarities between existing languages and the novel language might modulate this effect. In her study, the participants who learned via the L2 were also native speakers of a language that did not share script with the L2 or L3. A ripe area for future research will be to examine the interactions between script overlap and other features of a bilingual’s known languages with the language of instruction to optimize L3 word learning.

Metalinguistic awareness

One intuitively obvious benefit for bilinguals over monolinguals is the very experience of having learned a foreign language; as such, bilingual advantages in L3 learning are often attributed to metalinguistic awareness (e.g., Gibson & Hufeisen, 2003, 2006; Jessner, 2003; Klein, 1995; Thomas, 1988). However, relatively few authors include precise operational definitions of metalinguistic awareness, discussing concepts ranging from an understanding of language as a system to an awareness of learning strategies that have worked well in past language learning contexts.

Measures purported to assess metalinguistic awareness are also sparse and inconsistent throughout the literature. For example, Gibson and Hufeisen (2006) defined metalinguistic awareness as including “heightened abilities to differentiate, keep track of and manipulate … form vs. meaning” (p. 141). Based on a finding that multilingual learners of English performed well on a task requiring judgment of grammatical errors in the presence of semantic anomalies, they concluded that multilingualism may indeed confer advantages in metalinguistic awareness (although it is important to note that the study did not include any monolingual controls). Kemp (2007) focused on strategy use, examining grammar learning strategies in participants who knew between two and twelve languages each. The study did not test actual L3 learning or performance. However, questionnaire results revealed that individuals who knew more languages reported using more strategies, although it is important to note that there is no known relationship between number of strategies and language learning or performance. Bono and Stratilaki (2009) argue that an important factor that may be driving some of these multilingual advantages is a motivational one – individuals’ perceptions regarding their multilingualism; in other words, it is important for learners to view their multilingualism as a strategic asset in learning additional languages.

Although studies of metalinguistic awareness and related constructs hold promise for better understanding how past language learning experience can be leveraged in cross-training contexts, it will be important for researchers to develop precise operational definitions and include validated measures to allow for a more direct evaluation of the benefits to learning that multilingualism is claimed to confer.

MULTILINGUAL PEDAGOGY (IMPLICATIONS FOR INSTRUCTION)

In spite of the growing body of literature on multilingualism and L3 acquisition, there is still a lack of a systematic investigation of L3 instruction. Relevant publications concerning L3 instruction often have not had a strong research base and encompass opinion articles and papers based on teacher reflections. These publications generally suggest maximizing attempts to leverage students’ previous language knowledge and learning experience in the process of learning a consecutive language. However, how exactly this can be done has not been investigated or documented. What instructional techniques are most effective in L3 instruction? Should they differ from techniques used in any other foreign language classroom? If L3 acquisition is distinguished from L2 acquisition, should this difference be reflected in the instruction? Although available literature does not provide explicit answers to these questions, there is some evidence that may at least indirectly inform the issues.

Below we propose some ways in which implications for adult L3 language instruction can be derived from available empirical evidence on language factors such as objective and perceived proximities among languages as well as learner factors such as individual differences in executive control. It is important to note that the link
between available evidence and implications for instruction is, for the most part, solely our interpretation of how this evidence can be extended into L3 instruction. Moreover, we focus our discussion to factors relevant to L3 instruction in particular, not language acquisition in general.

Language factors

Objective features of languages

The relationship among all languages in the multilingual mind is crucial for L3 instruction, especially when it comes to their proximity, because this information can facilitate personnel selection for cross-training as well as the development of effective instructional techniques and materials. However, proximity among multiple languages cannot be easily measured or quantified on a large scale because of the large number of possibilities that need to be investigated, which can prove rather impractical. That is, developing relatedness measures among possible L1-L2-L3 triads would require consideration of a large number of possibilities; even if one language (e.g., English) is singled out as the starting point, there are still thousands of possible combinations. Despite the emergence of some promising approaches for estimating the relative distance among languages based on computational measures of entropy between parallel corpora (Nakhleh, Ringe, & Warnow, 2005), these methods have not been used to test learnability. This line of research may be very useful in planning language instruction on a large scale, such as in the US Government setting, for which it would be beneficial to identify ideal pairs of languages for optimal cross-training, especially conversion training. Although large-scale analyses of language proximity involving multiple languages are difficult to perform, identifying structural features of two languages can be successfully accomplished using available linguistic tools. One excellent and widely available tool that can be very useful in identifying and comparing structural features of languages is the World Atlas of Linguistic Structures (WALS; Dryer & Haspelmath, 2011), which encompasses a large database of phonological, grammatical, and lexical properties of hundreds of languages, with chapters describing given properties, comparison tables, and maps, allowing the user to compare selected properties for specific language combinations.

More traditional methods of language comparison have drawn on the works of comparative or contrastive linguistics, from which contrastive and error analyses developed. The two latter methods have received more criticism than praise in the last few decades for their inability to support their claims that they can either predict or explain learner’s errors based on their knowledge of the learner’s L1 and L2. Although this criticism is justified, and contrastive analysis has been shown to be ineffective when applied to foreign language learning (e.g., Klein, 1986; Tarone, 1979; Whitman & Jackson, 1972), its tools can be used for the purposes of describing linguistic systems in question.

It seems very relevant to use methods from descriptive and comparative linguistics as well as available tools, such as WALS, to describe a learner’s L1, L2, and L3. The outcomes of these comparisons can be used later to make learners aware of objective features of languages (both similarities and differences) so that the objective similarities can become perceived similarities, which should lead to positive transfer. Because language instructors, do not always have extensive background in linguistics, they will benefit from having linguistic tools for language description, which would give them means to acquire the background linguistic knowledge they can use to help their students to facilitate positive transfer and mitigate negative transfer.

The information about students’ backgrounds and their previous linguistic experience, in addition to students’ language use purposes, needs and goals, can be gathered through needs analysis that should happen during the course design stage (e.g., Brown, 2009). Needs analysis can be completed through a triangulation among survey of learners, in situ needs analysis, and interviews with job supervisors (Long, 2005). Curriculum developers and instructors familiar with their students’ linguistic backgrounds, needs, and goals, will be more knowledgeable and consequently better off when it comes to designing L3 courses and developing materials for these courses. Equipped with this knowledge and these materials, instructors and curriculum developers can help the learners to establish links between objective features of the languages and learners’ perceived similarities among languages, which should benefit learning by increasing positive transfer and attenuating negative transfer.
Perceived features of languages

For positive transfer to occur, learners must perceive similarities among languages (Jarvis, 2000; Kellerman, 1995; Odlin, 2003; Ringbom, 2001). Indeed, one implication of Kellerman’s seminal (1983) work discussed earlier is that learners themselves need to realize – or be made to realize – the similarities. Ringbom (2007) argued that what is important to the language learner is language proximity (i.e., similarities) and not language distance (i.e., differences). Teachers can facilitate this process by providing materials that explicitly point out similarities between a learner’s languages, for example, with reference to lexical items, or information on sound and case systems. Consequently, the more similar the features, the more time savings are possible because less attention may be required during L3 instruction (Gribble, 1987; Kulman & Tetrault, 1992). In L3 instruction, similarities should be identified and pointed out to students to facilitate positive transfer; differences, on the other hand, should also be identified and then explicitly taught in order to mitigate negative transfer. For example, Gribble (1987) stated that the notion of aspect in his Bulgarian course for learners with background in Russian does not receive much attention because the concept of aspect is essentially the same in both languages. Similarly, in Pois Nao: Brazilian Portuguese Course for Spanish Speakers, Simões (2008) focuses early on the sounds of Brazilian Portuguese that are not part of the inventory of Spanish sounds as well as morpho-syntactic differences between the two languages. The entire content of Ulsh’s (2011) From Spanish to Portuguese manual contains explicit comparisons between the two languages, including their sound systems, morphology, syntax, and lexicons. These approaches should benefit multilingual learners by making them more aware of similarities and differences, which can increase positive transfer and mitigate negative transfer. It is important to note that awareness of similarities and differences is most facilitative when they are fully perceived by learners. For example, Zobl (1982) notes that in L2 acquisition, zero relations between languages are sometimes facilitative, whereas close, but not exact, likeness results in a delay (i.e., negative transfer).

There is some empirical evidence that L3 learners can learn a new language in a shorter amount of time than L2 learners, especially when learning an L3 that is closely related to the L1 or L2 (see review in Rivers & Golonka, 2009). Generally, this evidence shows that adult L3 courses that are shorter than regular L2 courses can produce similar results (Corin, 1994; Rivers, 1996). Conversion courses are conceptualized based on an idea of the high degree of mutual intelligibility between language pairs, such as Spanish and Portuguese (Holton, 1954; Jensen, 1989; Jordan, 1991), Russian and Czech (Townsend, 1995), and Czech and Serbian/Croatian (Corin, 1994). Corin provided some data supporting a claim that in a conversion course, learning can happen much faster than in a regular L2 course. At the end of a 3-month conversion course involving 40 Czech linguists, the median oral proficiency on the ILR scale was 2 and the mode was 1+. Simões (2008) argues that his book teaches the equivalent of one year of college Portuguese in one semester; however it should be noted that the effectiveness of the course has not been empirically evaluated.

In sum, multilingual learners who perceive the similarity of linguistic features among their languages are more likely to experience positive transfer, suggesting that multilingual pedagogy should leverage these similarities by explicitly making students aware of them in order to enhance L3 learning. In contrast, awareness of differences in linguistic features may reduce the extent of negative transfer between a multilingual’s languages, and therefore multilingual instruction should explicitly teach differences among specific language groupings to facilitate the learner’s perception of these differences. That is, multilingual instruction should benefit from the implementation of methods aimed at increasing student awareness of similarities and differences.

Learner factors

Other types of potential methods for enhancing L3 instructional techniques come from studies investigating how multiple languages interact from a cognitive perspective. In this section, we speculate (because more research is needed) on a few ways in which the research reviewed in the first half of this report might be applied to the L3 instructional context.

The robust cross-language interactions involving cognates supports the current practice in L3 pedagogy of drawing the learner’s explicit attention to the existence of cognates (e.g., Simões, 2008). Similarly, transfer effects involving grammatical processing also suggest that instructors should make explicit any and all cases of direct overlap in syntactic features between the L3 and the L1 or L2. As discussed above in the section on
psychotypological similarity, making learners aware of any assumed and/or previously unnoticed between-language similarities should increase the likelihood of positive transfer, thereby facilitating learning. However, when overlap is not beneficial – such as situations in which assumed or perceived similarities do not represent true overlap and are in fact misleading – the instructor should explicitly point out this false overlap in order to mitigate any potential for negative transfer to lead to difficulties in L3 learning and/or use. For example, false cognates are words that overlap in form and sound but do not share the same meaning (e.g., room in Dutch, meaning cream). By making students aware of the presence of such false cognates and explicitly teaching those words, learners should be better prepared to reduce the effects of negative transfer.

The explicit discussion of these shared and similar features among known languages may also provide opportunities for learners to develop or be encouraged to use metalinguistic strategies to facilitate L3 learning and use. For example, if the L3 contains many cognates and few false cognates, learners may shift their focus to more explicitly take advantage of any overlap with the L1 and/or L2. In contrast, in situations in which the L3 has fewer cognates but a higher proportion of false cognates, learners may want to try to ignore or suppress the L1 or L2 – or at least attempt to minimize any tendency to rely on the other languages to attempt to access the meaning of an L3 word. In terms of methods for novel vocabulary learning, some preliminary evidence on L3 word learning suggests that, at least in the context of an explicit learning, paired associates task, learning L3 words via existing L1 words – rather than through L2 words – may facilitate learning (Bogulski, 2009). This finding suggests that during initial stages of learning, relying on the L1 (as the learner) and drawing attention to the L1 (as the instructor) may help learners to bootstrap into the L3 to begin establishing L3 lexical representations. It is possible that the established automaticity of lexical retrieval in the L1 allows the learner to focus attentional resources on making the association with the new L3 vocabulary word, suggesting that explicit learning situations (such as the paired associates task described above) might be more beneficial when they involve more automatized languages. Taking this hypothesis one step further, it might suggest that as multilingual learners develop automaticity in a number of languages, they may show a greater benefit from explicit learning techniques by virtue of the faster, more automatic lexical processing of the previously learned languages.

The structure of the multilingual lexicon according to the RHM would suggest that learning L3 words via existing L1 words would benefit learners due to their ability to rely on direct lexical links between the well-established L1 and the to-be-established L3, thereby facilitating access to the semantics of the associated words. Semantic access is critical because learning to communicate in the L3 requires learners to be able to access the meanings of words that they see or hear, and to retrieve word forms for production based on the intended message. By providing opportunities to more rapidly access the semantics, a stronger association between the novel L3 word and its underlying conceptual meaning could begin forming earlier in the learning process. As overall L3 proficiency increases and the L3 representations are strengthened, learners should be able to shift away from reliance on the L1 to access the semantics more directly via L3 lexical-conceptual links. Further research is needed to corroborate these preliminary results with other language pairs with differing extents of feature overlap, as well as with other types of word learning tasks. It will also be important to extend the learning paradigm beyond rote learning and recall and recognition outcome measures to investigate productive and receptive language use.

The findings on cognitive control that were reviewed earlier indicate that executive functions are relevant to understanding L3 learning and processing. This line of research suggests that learners and instructors should take advantage of these individual differences in any way possible. One such method could be to employ aptitude-treatment interaction (ATI) approaches, whereby instruction is tailored to characteristics of the individual learner to leverage strengths and mitigate weaknesses (for a recent review of ATI studies in L2 learning, see Vatz, Tare, Jackson, & Doughty, 2013). For example, as discussed above, inhibitory control abilities have been implicated in studies of L3 processing. Perhaps personnel with greater inhibitory control abilities could be selected for positions requiring cross-training or multilingual language learning. The integration of L3-specific factors as well as other factors known to affect SLA more generally could provide a powerful ATI pedagogical approach to enhance L3 learning. The systematic application of ATI methods to L3 instruction is a vital area of research for exploration that would allow the extant theoretical and empirical developments in psycholinguistic and SLA research on multilingualism to directly enhance L3 pedagogy, while also informing the broader SLA literature with respect to learning principles and the application of ATI methods.
Another approach could involve the use of training regimens to enhance cognitive abilities. Previous research suggests that focused cognitive training of the working memory (WM) system can lead to measureable benefits not only to memory processes but also to L2 processing, for instance the resolution of an ambiguous sentence (e.g., Novick, Hussey, Teubner-Rhodes, Harbison, & Bunting, 2013; for a recent review of the implications of cognitive training for language processing, see Hussey & Novick, 2012; for contrasting views on the efficacy of cognitive training methods, see, e.g., Shipstead, Redick, & Engle, 2012). There is a broad research base on L2 processing and learning that indicates that better WM is related to enhanced L2 outcomes (for a recent meta-analysis, see Linck, Osthus, Koeth & Bunting, under revision). This evidence suggests that cognitive training focusing on either enhancing WM abilities or developing learner strategies to better use WM may benefit L3 learning and L3 use. There remain many unanswered questions regarding the impact of individual differences in cognitive processes on L3 learning, and this exciting area of research has only recently begun to expand beyond bilinguals to examine multilinguals in a systematic way (e.g., see the trilingual switching studies of Linck et al., 2012; Philipp & Koch, 2009) that may have implications for the potential benefit of cognitive training for L3 learning.

A related potential direction is motivated by the claims that language switching relies on domain-general inhibitory control (e.g., Green, 1998), and that individual differences in inhibitory control abilities account for a learner’s ability to control interference from the L1 when speaking in the L3 (Linck et al., 2012). One potential implication of this body of research is that engaging in systematic multilingual language switching may provide a method to train/enhance one’s inhibitory control abilities while simultaneously gaining additional practice with the L3. Various manipulations of the type of linguistic materials included in the switching task (e.g., cognates, semantic categories, culturally-specific content) could provide practice managing cross-language interactions with task- or job-relevant material that is tailored to the learner’s needs. This exciting possibility for future research merits exploration in future empirical studies with multilingual learners and highly proficient multilinguals alike.

SUMMARY AND CONCLUSIONS

Our discussion of several prominent models of bilingual language representation and processing suggests that models such as the BIA+ and RHM can easily be adapted to multilingual contexts in which they could prove very useful for generating testable hypotheses about the nature of interaction among three or more languages. Once the IC Model is further specified to describe the nature of inhibitory mechanisms across multiple languages and tested, such an effort could shed light on the types of cognitive control required for successful multilingualism.

Although considerable evidence has now been amassed to show both facilitation (e.g., cognate effects) and interference (e.g., Stroop effects) among languages, further research is needed to disentangle the many factors that contribute to and/or moderate the occurrence of these kinds of transfer, such as relative proficiency, age of acquisition, individual differences in cognitive control, objective and perceived similarities among languages, and task-specific variables.

Numerous studies have also shown that bilinguals have advantages over monolinguals in learning a new language, perhaps due to factors such as metalinguistic awareness, automaticity in more than one language, and familiarity with multiple language learning strategies. More precise operational definitions and validated measures are required both to better understand the mechanisms underlying the bilingual advantage in subsequent language learning and to develop specific recommendations for leveraging that advantage in the cross-training classroom.

In Table 1 we have attempted to synthesize the findings reviewed in this report to develop some preliminary suggestions for incorporating evidence from psycholinguistic research into L3 course design and pedagogy. Given the previously mentioned lack of systematic investigation of L3 instruction, it is critical to bring rigorous scientific inquiry to bear on these questions. A multi-pronged approach including careful classroom studies and laboratory studies with an instructional focus is needed to inform and improve cross-training practices.
Table 1. Summary of implications for L3 course design and instruction.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Proposed Strategies</th>
<th>Method</th>
<th>Implementation Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design a relevant cross-training or conversion course</td>
<td>Perform needs analysis</td>
<td>Prior to the beginning of the course, collect information either on individual students’ language learning history, needs, and goals, or on a group of students’ needs and goals through survey of learners, interviews/focus groups with job supervisors, etc.</td>
<td>Triangulation among survey of learners, in situ needs analysis, interviews/focus groups with job supervisors. (Long, 2005)</td>
</tr>
<tr>
<td>Improve student selection for cross-training courses</td>
<td>Identify optimal language pairings for cross-training</td>
<td>Use available tools such as WALS</td>
<td>Select languages that share most features</td>
</tr>
<tr>
<td></td>
<td>Select students with demonstrated proficiency in a particular L2</td>
<td>Use the results of needs analysis (e.g., language learning history)</td>
<td>Select students with highest L2 proficiency in the selected languages</td>
</tr>
<tr>
<td>Maximize leveraging of students’ previous linguistic and metalinguistic knowledge</td>
<td>Develop resources that draw upon comparative descriptions of languages</td>
<td>Use objective descriptions of languages to identify similarities and differences</td>
<td>Explicitly discuss shared and similar features among languages</td>
</tr>
<tr>
<td></td>
<td>Encourage learners to use strategies for metalinguistic awareness to facilitate learning</td>
<td>Identify relevant strategies</td>
<td>Explicit strategy training to students</td>
</tr>
<tr>
<td>Facilitate positive transfer</td>
<td>Establish links between objective and perceived features of languages by capitalizing on similarities and differences among L1, L2, and L3</td>
<td>Develop materials based on objective features of languages and use instructional techniques to facilitate students’ awareness of the features</td>
<td>Identify or develop instructional techniques relevant to the current cross-training scenario</td>
</tr>
<tr>
<td>Reduce possibilities of negative transfer</td>
<td>Encourage learners to evaluate their assumed similarities and formulate perceived similarities, as appropriate</td>
<td>Change objective differences into perceived differences</td>
<td>Expose learners to a large amount of relevant input in which they will encounter corresponding features of the languages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify and correct student errors that are based on assumed similarities</td>
<td>Use implicit (recasts) and explicit (prompts, overt corrections, metalinguistic explanations) negative feedback, as appropriate</td>
</tr>
<tr>
<td>Facilitate vocabulary learning</td>
<td>Take advantage of the facilitative effects of cognates</td>
<td>Present cognates early on in instruction</td>
<td>If applicable, teach TL alphabet using cognates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify and teach triple cognates</td>
<td>Identify triple cognates using IBM’s Rich Lexical Explorer Tool</td>
</tr>
<tr>
<td>Leverage learner’s strengths and mitigate weaknesses</td>
<td>Employ ATI approaches</td>
<td>Tailor instruction to individual learners</td>
<td>Assess language aptitude, then provide more implicit learning tasks to better implicit learners (Jackson et al., 2012). For a summary of findings and methods of implementing ATI with L2 learning, see Vatz et al. (2013)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Enhance learning-relevant cognitive abilities</td>
<td>Use cognitive training regimes</td>
<td>Complete working memory training to enhance cognitive control (e.g., Novick et al., 2013) Engage in systematic multilingual language switching to enhance inhibitory control abilities</td>
<td>Have students complete working memory training immediately prior to instruction Have students name pictures, alternating among languages (see Linck et al., 2012, for a non-training version of a language switching task)</td>
</tr>
</tbody>
</table>
REFERENCES


© 2013 University of Maryland. All rights reserved.  October 2014 20


Corresponding Author and Reprints:
Jared Linck, PhD, University of Maryland Center for Advanced Study of Language, (301) 226-8879, jlinck@casl.umd.edu, www.casl.umd.edu.

Funding/Support: This material is based upon work supported, in whole or in part, with funding from the United States Government. Any opinions, findings and conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the University of Maryland, College Park and/or any agency or entity of the United States Government. Nothing in this report is intended to be and shall not be treated or construed as an endorsement or recommendation by the University of Maryland, United States Government, or the authors of the product, process, or service that is the subject of this report. No one may use any information contained or based on this report in advertisements or promotional materials related to any company product, process, or service or in support of other commercial purposes. This report is not Releasable to the Defense Technical Information Center per DoD Directive 3200.12. The Contracting Officer’s Representative for this project is John Walker, Government Technical Director at CASL, (301) 226-8912, jwalker@casl.umd.edu.