View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by UT Digital Repository

Disclaimer: This is a machine generated PDF of selected content from our databases. This functionality is provided solely for your convenience and is in no way intended to replace original scanned PDF. Neither Cengage Learning nor its licensors make any representations or warranties with respect to the machine generated PDF. The PDF is automatically generated "AS IS" and "AS AVAILABLE" and are not retained in our systems. CENGAGE LEARNING AND ITS LICENSORS SPECIFICALLY DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES FOR AVAILABILITY, ACCURACY, TIMELINESS, COMPLETENESS, NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Your use of the machine generated PDF is subject to all use restrictions contained in The Cengage Learning Subscription and License Agreement and/or the Gale Virtual Reference Library Terms and Conditions and by using the machine generated PDF functionality you agree to forgo any and all claims against Cengage Learning or its licensors for your use of the machine generated PDF functionality and any output derived therefrom.

Title: Rehabilitation in bilingual aphasia: evidence for within- and between-language generalization
Author(s): Swathi Kiran, Chaleece Sandberg, Teresa Gray, Elsa Ascenso and Ellen Kester
Source: ***American Journal of Speech-Language Pathology.*** 22.2 (May 2013): pS298.
Document Type: Clinical report
DOI: http://dx.doi.org/10.1044/1058-0360(2013/12-0085)
Copyright: COPYRIGHT 2013 American Speech-Language-Hearing Association
http://ajslp.asha.org/
Abstract:
Purpose: The goal of this study was to examine if there was a principled way to understand the nature of rehabilitation in bilingual aphasia such that patterns of acquisition and generalization are predictable and logical.

Method: Seventeen Spanish-English bilingual individuals with aphasia participated in the experiment. For each participant, three sets of stimuli were developed for each language: (a) English Set 1, (b) English Set 2 (semantically related to each item in English Set 1), (c) English Set 3 (unrelated control items), (d) Spanish Set 1 (translations of English Set 1), (e) Spanish Set 2 (translations of English Set 2; semantically related to each item in Spanish Set 1), and (f) Spanish Set 3 (translations of English Set 3; unrelated control items). A single-subject experimental multiple baseline design across participants was implemented. Treatment was conducted in 1 language, but generalization to within- and between-language untrained items was examined.

Results: Treatment for naming on Set 1 items resulted in significant improvement (i.e., effect size >4.0) on the trained items in 14/17 participants. Of the 14 participants who showed improvement, within-language generalization to semantically related items was observed in 10 participants. Between-language generalization to the translations of trained items was observed in 5 participants, and between-language generalization to the translations of the untrained semantically related items was observed in 6 participants.

Conclusion: The results of this study demonstrated within-and between-language patterns that were variable across participants. These differences are indicative of the interplay between facilitation (generalization) and inhibition.

Key Words: aphasia, bilingualism, language disorders, neurologic disorders, intervention

Full Text:
It is estimated that 60% of the world is bi/multilingual. Within the United States, Spanish-English bilingualism is the largest growing bilingual population. Currently, 55 million individuals (~20%) in the United States are Spanish speakers (Shin & Kominski, 2010). Obviously, this translates to an increase in clinical need to address the rehabilitation of bilingual individuals with aphasia, but no clear guidelines exist on how to do so. Although there is research that explores how bilingual individuals' language systems are organized and function, there has been insufficient research on this topic in bilingual individuals with aphasia (Lorenzen & Murray, 2008), although attention to the topic is increasing due to the practical demands of serving this clinical population (Kohnert, 2004; Laganaro, Di Pietro, & Schnider, 2006; see recent chapters in Gitterman, Goral, & Obler, 2012).

A recent review of 13 studies on bilingual aphasia rehabilitation (Faroqi-Shah, Frymark, Mullen, & Wang, 2010) focused on the effectiveness of rehabilitation of language deficits in individuals with bilingual aphasia. Except for one study with 30 participants (Junque, Vendrell, Vendrell-Brucet, & Tobena, 1989), most of the studies were case studies. In general, Faroqi-Shah et al. (2010) observed that treatment provided in the second language (L2) resulted in improved treatment outcomes in that language. Further, between-language transfer occurred in more than half of the participants. Interestingly, the age of acquisition (AoA) and language differences across the 13 studies did not specifically influence the treatment outcomes. However, there was quite a bit of variability in treatment type and consequent treatment outcomes.

A few of the studies mentioned in Faroqi-Shah et al.'s (2010) review and some others not mentioned have specifically examined the issue of between-language generalization and will be briefly discussed here. For instance, cuing hierarchy treatment (i.e., when increasing/decreasing cues are systematically given to promote naming accuracy) in English or Spanish did not yield between-language generalization for one Spanish-English bilingual individual with transcortical motor aphasia, as measured by the Naming subtest of the Bilingual Aphasia Test (BAT; Paradis, 1989) (Galvez & Hinckley, 2003; Hinckley, 2003). The individual's overall improvement on the BAT was greater in Spanish than English, but naming improvement on the BAT was equal across the two languages. In another study, Kohnert (2004) examined the effect of cognitive-based treatment and lexical-based treatment on generalization in one Spanish-English bilingual individual with severe nonfluent aphasia. This individual showed between-language generalization for cognates but not for noncognates. However, generalization to cognates is not necessarily a remarkable finding given the phonological and semantic overlap for cognates in the two languages.

Recently, Miller Amberber (2012) examined one French-English individual who was French dominant who demonstrated greater impairment in English relative to French. This individual was trained in English and improved in the trained language but not in French, indicating a language-specific improvement as a function of treatment. In contrast, Miertsch, Meisel, and Isel (2009) trained a German-, English-, and French-speaking trilingual in his third language (L3, French) and found that both his L3 and L2 (English) improved as a function of treatment. Likewise, Goral, Rosas, Conner, Maul, and Obler (2012) examined a Spanish-, German-, French-, and English-speaking individual who received treatment in the weaker language and found improvements in the trained language as well as some between-language generalization to the untrained languages. In another study, Goral, Levy, and Kastl (2010) found selective generalization from trained L2 (English) to L3 (French) but not to the first language, or L1 (Hebrew), in a trilingual individual with agrammatic deficits.

When treatment is targeted toward naming deficits, there is a relatively strong theoretical foundation from bilingual lexical semantic processing that allows specific predictions about between-language generalization to be generated. For instance, the revised hierarchical model (RHM; Kroll & Stewart, 1994) allows for language proficiency differences by proposing connections between both L1 and L2 and the semantic system (Kroll, Bobb, Misra, & Guo, 2008; Kroll & Stewart, 1994; Kroll, van Hell, Tokowicz, & Green, 2010); these connections differ in their strengths as a function of fluency in L1 relative to L2. In bilingual individuals with a dominant language, the lexicon of L1 is generally assumed to be larger than that of L2 because more words are known in the dominant language. Also, lexical associations from L2 to L1 are assumed to be stronger than those from L1 to L2. Conversely, the links between the semantic system and L1 are assumed to be stronger than between the semantic system and L2.

With regard to activation of phonological representations from the semantic system, the prevailing theory suggests that activation flows from the semantic system to the phonological system of both languages simultaneously, indicating that lexical access is target language nonspecific (Costa, La Heij, & Navarrete, 2006; Finkbeiner, Gollan & Caramazza, 2006). An alternate, but not neccessarily contradictory, hypothesis is that in order for bilingual individuals to access the target language, the nontarget language must be inhibited (Green, 1986, 1998). In other words, a speaker activates target language lemmas while simultaneously inhibiting the lemmas of the nontarget language. Support for Green's model (1986, 1998) comes from studies examining between-language translation in normal bilingual individuals, where translation from the stronger language to the weaker language occurs in both early bilinguals (e.g., Gollan, Forster, & Frost, 1997) and late bilinguals (e.g., Jiang, 1999; Williams, 1994). More recent studies have shown an asymmetric cost of translating from the stronger language to the weaker language (Costa, Santesteban, & Ivanova, 2006; Grainger & Frenck-Mestre, 1998) because it takes more effort to inhibit the stronger language compared to the weaker language. In contrast, as the bilingual is more balanced, the asymmetry decreases (Costa et al., 2006).

Previous work in our lab examining a semantic-based treatment to improve naming in bilingual individuals with aphasia was based on these mutually overlapping theories, with the specific prediction that training semantic attributes for targets in one language would improve naming in that language and facilitate generalization to untrained semantically related items in the trained language and translations of the trained and untrained items in the untrained language (Edmonds & Kiran, 2006). In that study, three English-Spanish bilingual individuals with aphasia demonstrated a within- and between-language effect on generalization related to prestroke language proficiencies.

In a follow-up study, Kiran and Roberts (2010) administered the same semantic-based treatment to improve picture naming in two English-Spanish bilingual individuals with aphasia and two English-French bilingual individuals with aphasia and measured generalization to translations of the trained words and to untrained semantically related words to the target words in each language. The performance of all four participants was highly variable but reflected both within- and between-language effects on generalization. Importantly, in addition to the previously identified factors including prestroke language proficiency and AoA of each language, other factors such as poststroke level of language impairment and type and severity of aphasia also influenced the treatment outcomes. Given the multidimensional factors that potentially influence naming impairment and recovery in individuals with aphasia, it is still not clear whether treatment is effective in improving naming performance of the trained items and/or language. Further, it is not clear if generalization occurs, when it occurs, and under what circumstances it does not occur.

Current Study

The goal of our study was to examine if there was a principled way to understand the nature of rehabilitation in bilingual aphasia such that patterns of acquisition and generalization are predictable and logical. In this study, we examined a large group of participants (N = 17) who had received treatment to improve naming in one language. We asked the following three questions:

* What are the effects of treatment on the acquisition of trained items independent of the language in which training was given? Based on the meta-analytical review by Faroqi-Shah and et al. (2010) and other work since, we hypothesized that irrespective of the language trained, treatment provided in one language should improve naming of items in that language.

* What are the effects of treatment on generalization to translation items and untrained items independent of what language is trained? Given the extensive work in monolingual aphasia demonstrating that training semantic attributes results in improved naming of targets as well as generalization to semantically related items (e.g., Kiran & Thompson, 2003; Kiran, Sandberg, & Abbot, 2009), one main prediction of our work was that strengthening semantic features should improve access to trained items within the language trained and to semantically related neighbors within that language (see Figure 1). Relatedly, a second prediction stemming from these models was that lexical-semantic connections between L1 and L2 are linked, and lexical access is target language nonspecific (e.g., Costa, La Heij, & Navarrete, 2006; Hermans, Bongaerts, de Bot, & Schreuder, 1998). Therefore, we expected between-language generalization to occur as a function of treatment because repeated exposure to items in one language should result in improved access to the translations in the untrained language (see Figure 1). We, however, expected that patterns of generalization would vary across participants and would depend on individual participants' language use and impairment profiles.

* What impairment and language use factors influence treatment outcomes? Although individual case studies have interpreted their results both in terms of the level of impairment between the two languages and the nature of premorbid language use and proficiency, we expected to observe a systematic positive relationship between the level of premorbid proficiency in a language and generalization to that language as well as a negative relationship between the level of language impairment and improvements in each language.

[FIGURE 1 OMITTED]

Method

Participants

Seventeen individuals with bilingual aphasia (six male, 11 female) participated in our experiment. Five of these participants have been reported on previously (Edmonds & Kiran, 2006; Kiran & Roberts, 2010). All participants were at least 5 months post onset from a left perisylvian area cerebrovascular accident (except one who had a gunshot wound) and ranged in age from 33 to 87 years (M = 58.84, SD = 17.66). Thirteen participants were recruited from the Austin, TX, area; the remaining four were recruited from the Boston, MA, area. All participants were native Spanish speakers, and English was their L2. Participant education ranged from elementary school to college (M= 10.78 years, SD = 4.34).

Assessment of language impairment. Participants were administered the Pyramids and Palm Trees Test (PPT)--Picture Version (Howard & Patterson, 1992) to measure language-independent semantic processing, the Boston Naming Test (BNT; Kaplan, Goodglass, & Weintraub, 1983) in both Spanish and English to measure confrontation naming in both languages, and the BAT in both Spanish and English to determine the degree of overall impairment in both languages. For the purpose of this paper, BAT-Comp-E and BAT-Comp-S are averages from the Pointing, SemiComplex Commands, and Complex Commands subtests in each language. BAT-Sem-E and BAT-Sem-S are averages from the Semantic Categories, Synonyms, Antonyms I and II, Semantic Acceptability, and Semantic Opposites subtests in each language. Finally, BAT-Trans S into E and BAT-Trans E into S are averages from the Translation of Words and Translation of Sentences subtests in each language. Performance on these measures for each of the 17 participants is listed in Table 1.

Assessment of language proficiency. Measures of language AoA, use, and proficiency were obtained for all participants by administering a comprehensive questionnaire to each participant and/or his or her family members. The Language Use Questionnaire (LUQ; Kiran, Pena, Bedore, & Sheng, 2010) covers the following information specific to each language: (a) AoA, (b) amount of language exposure during the entire lifetime, (c) educational history in terms of both the language of instruction and the language used by peers, (d) confidence of skill in each language, (e) time spent conversing in each language during his or her daily routine after the stroke (poststroke exposure), (f) proficiency of immediate family members, and (g) a self-rating of pre- and poststroke proficiency in each language. For prestroke language exposure, a weighted average of the proportion of exposure across the life span in hearing, speaking, and reading domains was obtained for each language. Likewise, a weighted average of the exposure in each language calculated hour by hour during a typical weekday and typical weekend reflected the proportion of poststroke language exposure in each language. Finally, an average proportion score in terms of the participant's ability to speak and understand the language in formal and informal situations in each language reflected participants' perceptions of their own language proficiency. For the purpose of this paper, we calculated an average language use and proficiency value for the aforementioned factors in order to determine a composite picture of dominance in either of the languages. Details regarding the participants' language background are provided in Table 2.

Stimuli

Target treatment items for all participants were selected from a corpus of 300 nouns that were gathered from our previous treatment studies for word finding in aphasia in both monolingual and bilingual populations (Edmonds & Kiran, 2006; Kiran, 2008; Kiran & Basset to, 2008; Kiran & Johnson, 2008; Kiran & Thompson, 2003). Rather than proceeding with a prechosen set, we chose target items for each participant based on a confrontation naming pretest; hence, the number of stimuli and the specific stimuli trained during treatment differed for each participant. Six individualized stimulus sets were created for each participant: English Set 1 (e.g., celery), Spanish Set 1 (e.g., apio), English Set 2 (e.g., cabbage), Spanish Set 2 (e.g., repollo), English control Set 3 (e.g., cow), and Spanish control Set 3 (e.g., vaca). Thus, Set 1 and Set 2 consisted of semantically related items, whereas Set 3 consisted of an unrelated control set. Table 3 lists the number of trained items for each participant.

All word pairs were category coordinates (e.g., horse and sheep). Cognates (e.g., elephant and elefante) and words with at least 50% phonetic similarity (e.g., cat and gato)were eliminated. The lists were balanced for average frequency (Bates et al., 2003; Frances & Kucera, 1982) and number of syllables. For each item to be trained, 12 semantic features were chosen from a database of 261 binary semantic features assembled for items across categories. For each target item (e.g., celery), six of the features were associated with the item, and six were not. Care was taken to ensure that each associated/nonassociated pair belonged to one of six categories: category (e.g., is a vegetable), location (e.g., is found in a grocery store), physical (e.g., is green), function (e.g., is eaten), characteristic (e.g., is juicy), and association (here the participant makes his or her own association, such as crunchy for the example of celery).

Treatment Procedure

To facilitate access to the naming of trained items, a semantic treatment was implemented. These procedures have been described in detail previously and are briefly summarized here (Edmonds & Kiran, 2006; Kiran & Roberts, 2010). All participants received treatment two times per week, for 2 hr each session. For each target item, participants performed five treatment steps that emphasized semantic feature attributes of that particular item. First, individual participants were shown a picture of an item and were asked to label/name the item. Next, each participant was asked to choose five features (from a field of 10) that belonged to that item. Each feature belonged to a different feature class: (a) superordinate label (e.g., belongs to), (b) function (e.g., is used for), (c) characteristic (e.g., has/is), (d) physical attribute (e.g., is made of/appears), and (e) location (e.g., is found). After these five features were chosen, the participant was asked to generate an association and a nonassociation (e.g., reminds me of/doesn't remind me of). Following this, the participant was asked yes/no questions about the relationship of the semantic features with the target item and was required to accept or reject these and other features as being applicable to the target item. Finally, the participant was asked to name the picture again.

The average length of treatment was 10.5 weeks (range of 7-13 weeks). Treatment was discontinued when naming accuracy met 80% for the trained items on two consecutive weekly picture-naming probes or when 20 sessions were completed. All participants were trained in one language during the course of treatment. Naming probes were administered in both languages, consisted of the same stimuli as those presented during baseline, and always preceded every other treatment session.

Data Analysis

Before treatment, three, four, or five naming probes were given to the participants in order to establish a baseline; the specific number of baseline probes varied across participants. Following treatment, two or three post-treatment probes were administered to 11/17 participants. Four participants (UT11, UT01, UT09, UT17) received treatment in the L2 after completion of the first treatment; however, only the first phase of treatment is reported here. The extent to which changes from baseline to the posttreatment phase are statistically reliable was determined by calculating effect sizes (ESs). ES was calculated by comparing the mean of all data points in the posttreatment phase relative to the baseline mean divided by the standard deviation of the baseline data points. For the six participants who were not administered posttreatment probes, ES was calculated from the final three treatment probes. The benchmarks set for the present study were 4.0 (small ES) and 10.0 (large ES) (Beeson & Robey, 2006).

[FIGURE 2 OMITTED]

Results

Results for the participants in this study are presented according to the questions posed. Nine participants were trained in English, and eight were trained in Spanish. Thus, instead of discussing the results in terms of English/Spanish, the results are discussed in terms of Trained Language Set 1, Set 2, and Set 3 and Untrained Language Set 1, Set 2, and Set 3.

Effects of Treatment on Acquisition of Trained Items

When examining the effects of treatment on the trained language, independent of what language was trained, 14 of the 17 participants (82%) showed an ES >4.0 and nine (52%) showed an ES >10.0. Indeed, most of the participants improved on the trained items relative to the unrelated control items (see Figure 2). Only one participant (UT16) showed improvements in the Set 3 control items (trained language), with ES >4.0. Additionally, a one-way analysis of variance (ANOVA) (1) on the trained ES with language as the independent variable revealed that training in Spanish resulted in higher ESs than training in English, $F(1, 15) = 5.18$, $p = .03$, indicating that overall, participants showed greater gains in Spanish than in English.

Generalization to Untrained Items Within and Between Language

Using the same criterion for ES (>4.0) for generalization, Table 3 shows that six participants met that criterion for semantically related items within the trained language (Set 1 to Set 2), three participants met that criterion for between-language generalization from Trained Language Set 1 to their translations (Untrained Language Set 1), two participants met the criterion for between-language generalization from trained Language Set 1 to Untrained Language Set 2, and two participants met that criterion for control items in the untrained language. To corroborate these relatively subjective criteria for generalization, we performed crosscorrelation function analyses using the autoregressive integrated moving average procedure in SPSS. For each time series, a regression line is fit to the actual data and the residuals are calculated for that data. Then, crosscorrelations are calculated on the residuals and are averaged over time (Box, Jenkins, & Reinsel, 1994).

In our study, for each participant, we correlated the time series between (a) trained items and untrained items in the same language and (b) trained items and untrained items in the other language at 10 lag points (-5 to 5). Correlations that exceeded .50 and exceeded two standard errors were deemed statistically significant and are represented in Figure 3. Three participants (UT20, UT21, BU12) did not have enough nonzero data points to include in the analysis. For the remaining 14 participants, we first examined crosscorrelation coefficients for the items in Set 1 (trained) versus Set 2 (untrained) of the corresponding language (i.e., within-language generalization). Ten of the 14 participants exhibited a significant relationship between Trained Set 1 and Set 2 of the same language. Note that these sets of words were semantically related to each other (e.g., celery in English Set 1, cabbage in English Set 2).

Next, we examined crosscorrelation coefficients for items in the Trained Language Set 1 versus Untrained Language Set 1 (i.e., between-language generalization). Five of the 14 participants exhibited a significant relationship. Note that these sets of words are translations of each other (e.g., celery in English Set 1, apio in Spanish Set 1). Finally, we examined crosscorrelation coefficients for the items in the Trained Language Set 1 versus Untrained Language Set 2 (i.e., between-language generalization), which revealed a significant relationship for six of the 14 participants. Note that these sets of words were semantically related words in different languages (e.g., celery in English Set 1, repollo in Spanish Set 2).

As shown in Figures 1 and 3, different participants showed different patterns of within- and between-language generalization. Three participants (UT07, UT23, BU07) showed both between- and within-language generalization (Figure 1: 1, 2, and 3). Five participants (UT19, UT16, UT01, UT11, UT09) showed only within-language generalization (Figure 1: 1). Two participants (UT18, UT22) showed between-language generalization only to translations in the untrained language (Figure 1: 2), and three participants (UT02, BU01, BU04) showed within-language generalization and between-language generalization only to semantically related untrained items in the untrained language (Figure 1: 1,3). Importantly, every participant who showed between-language generalization to the semantically related items also showed within-language generalization to those items.

Impairment and Language Use Factors Influence Treatment Outcomes

Given the limited number of participants (N =17)in our study, we chose to compute a nonparametric Spearman correlation for language impairment factors such as PPT (language independent semantic processing), BNT-E and BNT-S (language-specific lexical access), BAT-Comp-E and BAT-Comp-S (language-specific comprehension), BAT-Sem-E and BAT-Sem-S (language-specific semantic processing), Ave-E and Ave-S (average prestroke language use in each language), AoA-English (there was no variance in AoA-Spanish), and Trained Language Set 1ES. The results of the correlation matrix are provided in Table 4 and show several significant positive relationships between language impairment variables such as (a) BNT in English and Spanish, (b) BNT and BAT comprehension, and (c) BAT comprehension and BAT semantic, indicating significant relationships between impairments in naming, comprehension, and semantic processing in the two languages. Of note, AoA in English negatively correlated with an average composite of the various language use and proficiency variables in English (i.e., the later English was learned, the less proficient the individual was in English) but positively correlated with the average use and proficiency in Spanish. A moderate correlation was observed between Trained Language Set 1 ESs and PPT and BAT-Sem-S scores. Likewise, a moderate correlation was observed between Untrained Language Set 1 ESs and BNT-Spanish and BAT-Comp-S.

[FIGURE 3 OMITTED]

Discussion

The goal of this study was to examine the nature of within- and between-language generalization following semantic-based naming treatment in individuals with Spanish-English bilingual aphasia. Our hypothesis was that all participants would improve on the items that were trained and would likely show both within- and between-language generalization, but that these patterns would vary based on individual language profiles. In general, results of this study showed that naming treatment resulted in improvements on trained items irrespective of language trained, although training in Spanish, which was the native language for all speakers, resulted in greater outcomes than training in English. It is not immediately clear why this would be the case; of the participants trained in Spanish, half of them were Spanish-dominant speakers and half were English-dominant speakers. Interestingly, participant scores on the three-picture version of the PPT and the BAT semantic scores in Spanish were significantly associated with higher treatment outcomes, indicating that participants who showed the most improvements also had higher semantic processing abilities.

With regard to generalization, data from the 17 participants were segregated into five subgroups. Three participants (UT07, UT23, BU07) showed both within- and between-language generalization, suggesting that strengthening semantic features improves access to (a) trained items (e.g., ballena) within the trained language, (b) semantically related neighbors (e.g., tiburon) within the trained language, and (c) translations of these items in the untrained language. In the second subgroup, five participants (UT19, UT16, UT01, UT11, UT09) showed only within-language generalization, indicating that for these participants, the impact of the semantic feature treatment was limited to semantically related items within the trained language. Improvements in the semantically related untrained items within the trained language indicated that treatment targeted at emphasizing semantic features improved access to trained items as well as semantically related items irrespective of which language was trained (Kiran & Bassetto, 2008). Two participants (UT18, UT22) showed between-language generalization only to translations in the untrained language but no within-language generalization to semantically related items. This is a surprising finding, and unfortunately, because there are only two participants who showed this pattern, it is hard to draw any meaningful interpretations. In the fourth subgroup, three participants (UT02, BU01, BU04) showed within-language generalization and between-language generalization only to semantically related untrained items in the untrained language. Importantly, every participant who showed between-language generalization to the semantically related items also showed within-language generalization to those items. Notably, both the first group of three participants who showed within- and between-language generalization and the fourth group of three participants who showed within- and between-language generalization showed relatively minor differences between English and Spanish BNT and BAT scores.

A final, fifth group consisted of four participants: UT17 and BU12 (who were not entered into the crosscorrelation analysis) did not show any generalization patterns and no changes beyond the trained items, and UT20 and UT21 did not show any improvements in the treatment. For the former two participants, there is nothing apparent from the test results that can be construed as a possible explanation for the results. Also, they are the only ones who showed a pattern that sometimes occurs in aphasia treatment, of no generalization beyond the trained items. The latter two participants were very severely impaired in their output, as evidenced by their very low scores on the various tasks reported in Table 1.

In order to account for the generalization mechanisms across these subgroups of participants, we propose an integrative framework comprising two mutually overlapping mechanisms mentioned in the introduction that may influence the treatment effects. One mechanism is that of spreading activation, which is a generalized mechanism of increasing activation as a function of treatment of both target words and their semantically related neighbors in both the trained language and the untrained language (Kiran & Bassetto, 2008; Kiran & Sandberg, 2011). The second mechanism is one of inhibitory control. In the context of the present study, there seem to be at least two forms of inhibitory control at play--one between semantically related items within one language, which has been reported extensively in studies of monolingual lexical-semantic processing (Belke, Meyer, & Damian, 2005; Bloem, van den Boogaard, & La Heij, 2004; Damian & Martin, 1999; Starreveld & La Heij, 1995) and in studies of blocked cyclic naming in aphasia (Hsiao, Schwartz, Schnur, & Dell, 2009), and the second pertaining to bilingual inhibitory control, as proposed by Green's (1986, 1998) model to address the issue of language control during language production.

Returning to our data, the ideal case scenario for positive within- and between-language generalization is when increased activation due to the general effects of treatment outweighs the inhibition/interference of specific items during lexical selection. The first subgroup of three participants who showed both within- and between-language generalization appeared to show this equilibrium between the general facilitative effects of increased activation as a function of treatment and optimal inhibitory control such that during the weekly naming probes, these participants showed increased naming accuracy across the sets of stimuli. In addition, inspection of the first subgroup's language impairment and language use profiles did not reveal any trends in terms of language use, but in general, these participants showed relatively minor differences between their English and Spanish BNT and BAT scores, suggesting that equal levels of language impairment post stroke may have some influence on the extent of generalization.

In the second subgroup of participants who showed only within-language generalization, the between-language inhibition mechanisms (Green's Inhibitory Control model, 1986, 1998) may have been stronger than the generalized increased activation as a function of treatment. Of note, four of the five participants in this subgroup were trained in English, and three of these four participants had higher average prestroke language use and/or poststroke language impairment scores in English relative to Spanish. Two of these participants were provided treatment in their weaker language and also only showed within-language generalization. What may be the precise mechanisms driving the interaction between facilitation and inhibition for these participants remains unclear;

however, as will be discussed below, generalization patterns are influenced by language use, language dominance, and language impairment. Future work will need to carefully contrast language inhibition and control with nonlinguistic control tasks as was conducted by Green et al. (2010) in a case study in the context of rehabilitation.

In the next subgroup of participants who showed generalization only to the between-language translations, it appears that the within-language interference precluded increased activation to semantically related targets, although the between-language inhibitory control works in positive tandem with increased activation. Both of these participants were trained in Spanish, which was also the stronger language pre stroke (i.e., higher average composite scores in Spanish relative to English). Patterns of generalization for these two participants are at odds with the patterns for participants like UT16 and UT01 from the previous subgroup, who were also trained in their stronger language but showed within- and not between-language generalization. One way to resolve this apparent discrepancy in the data is to examine each of these four participants individually. Both UT16 and UT01 learned English early in life and reported stronger English language use and proficiency relative to Spanish. When these two individuals were trained in English, perhaps the lack of continuous exposure to Spanish (e.g., attrition) and the language of the environment (English) may have resulted in within-language generalization to untrained targets in English. On the other hand, UT18 and UT22 learned English later in life and reported stronger Spanish language use and proficiency relative to English. The combination of the later AoA of English and the language of the environment (and perhaps the native language of the clinicians) may have facilitated easier access to untrained targets in English (hence, the between-language generalization).

These observations raise interesting questions about the presumed benefits of early bilingualism in terms of novel word learning (Kaushanskaya, & Marian, 2009; Kaushanskaya, & Rechtzigel, 2012), and by extension, facilitation of word retrieval after rehabilitation. Also, it appears that the language of the environment and that of the treating clinicians also likely plays a role in the extent of between-language generalization. These observations are speculative at this point and require further study. A few more observations can be made about the influence of individual participants' language use and backgrounds and how they may have influenced treatment outcomes. Table 2, Table 3, and Figure 3 show that of the 17 patients, seven (UT07, BU07, UT19, UT09, BU01, BU04, BU12) were trained in their weaker language, and of these, four showed some form of within- and between-language generalization.

A final note about the factors influencing treatment outcomes that emerged from the correlational analysis: Not surprisingly, several significant correlations were observed between naming, comprehension, and semantic processing in English and naming and semantic processing in Spanish. These findings underscore the relationship between receptive and expressive language impairments in each of the two languages in bilingual individuals with aphasia (Gray & Kiran, in press). Treatment outcome in the trained language was associated with semantic scores on the PPT, indicating that participants with better semantic processing abilities improved more in treatment. Interestingly, ESs for the trained language items and their translations correlated with the participants' scores on the language assessments in Spanish (BNT, BAT-Comp, and BAT-Sem) and may be related to another observation that ESs were higher when treatment was provided in Spanish than in English. Importantly, the average language use measure did not correlate with treatment outcomes or impairment measures, but was associated with AoA of English. Given these results, it is possible that creating a composite/average number to capture an individual's level of language proficiency may not be ideal or meaningful (Kiran & Roberts, 2012) in terms of interpreting behavioral impairment or treatment outcomes.

== Given that there were 17 participants in this study, we can begin to address the potential, albeit complicated, influence of several facets of language proficiency, language impairment, and language use on the treatment outcomes, a notable contribution of this study. That said, we acknowledge that no strong conclusions can be drawn regarding the potential influence of one or more of the abovementioned variables on the treatment outcome.

Conclusion

The results of this study demonstrate the beneficial effects of a semantic-based naming treatment for individuals with bilingual aphasia. In addition, within- and between-language patterns were variable across participants, and these differences are indicative of the interplay between facilitation (generalization) and inhibition and appear to be influenced by language proficiency, use, and the individual's current language environment. In general, these results have implications for theoretical models of bilingual language processing and the rehabilitation of individuals with bilingual aphasia.

Acknowledgments

A portion of this research was supported by National Institute on Deafness and Other Communication Disorders Grant R21DC009446 and a Clinical Research Grant from the American Speech-Language-Hearing Foundation to the first author. The authors would like to thank Danielle Tsibulsky, Anne Alvarez, and Rajani Sebastian for their assistance in data collection and analysis. The authors would also like to thank all of the participants for their time and cooperation.

References

Bates, E., D'Amico, S., Jacobsen, T., Szekely, A., Andonova, E., Devescovi, A., ... Tzeng, O. (2003). Timed picture naming in seven languages. Psychonomic Bulletin Review, 10(2), 344-380.

Beeson, P. M., & Robey, R. R. (2006). Evaluating single-subject treatment research: Lessons learned from the aphasia literature. Neuropsychological Review, 16(4), 161-169.

Belke, E., Meyer, A. S., & Damian, M. F. (2005). Refractory effects in picture naming as assessed in a semantic blocking paradigm. Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology, 58, 667-692.

Bloem, I., van den Boogaard, S., & La Heij, W. (2004). Semantic facilitation and semantic interference in language production: Further evidence for the conceptual selection model of lexical access. Journal of Memory and Language, 51, 307-323.

Box, G., Jenkins, G. M., & Reinsel, G. (1994). Time series analysis: Forecasting & control. Upper Saddle River, NJ: Prentice Hall.

Costa, A., La Heij, W., & Navarrete, E. (2006). The dynamics of bilingual lexical access. Bilingualism: Language and Cognition, 9(2), 137-151.

Costa, A., Santesteban, M., & Ivanova, I. (2006). How do highly proficient bilinguals control their lexicalization process? Inhibitory and language-specific selection mechanisms are both functional. Journal of Experimental Psychology: Learning, Memory, and Cognition, 32(5), 1057-1074.

Damian, M. F., & Martin, R. C. (1999). Semantic and phonological codes interact in single word production. Journal of Experimental Psychology: Learning, Memory, and Cognition, 25, 345-361.

Edmonds, L. A., & Kiran, S. (2006). Effect of semantic naming treatment on crosslinguistic generalization in bilingual aphasia. Journal of Speech, Language, and Hearing Research, 49, 729-748.

Faroqi-Shah, Y., Frymark, T., Mullen, R., & Wang, B. (2010). Effect of treatment for bilingual individuals with aphasia: A systematic review of the evidence. Journal of Neurolinguistics, 23(4), 319-341.

Finkbeiner, M., Gollan, T. H., & Caramazza, A. (2006). Lexical access in bilingual speakers: What's the (hard) problem? Bilingualism: Language and Cognition, 9(2), 153-166.

Frances, N., & Kucera, H. (1982). Frequency analysis of English usage. Boston, MA: Houghton Mifflin.

Galvez, A., & Hinckley, J. J. (2003). Transfer patterns of naming treatment in a case of bilingual aphasia. Brain and Language, 87, 173-174.

Gitterman, M., Goral, M., & Obler, L. K. (2012). Aspects of multilingual aphasia (Vol. 1). Clevedon, UK: Multilingual Matters.

Gollan, T. H., Forster, K. I., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and noncognates in Hebrew-English bilinguals. Journal of Experimental Psychology: Learning, Memory, and Cognition, 23(5), 1122-1139.

Goral, M., Levy, E., & Kastl, R. (2010). Cross-language treatment generalization: A case of trilingual aphasia Aphasiology, 24(2), 170-187.

Goral, M., Rosas, J., Conner, P. S., Maul, K. K., & Obler, L. K. (2012). Effects of language proficiency and language of the environment on aphasia therapy in a multilingual. Journal of Neurolinguistics, 25(6), 538-551.

Grainger, J., & Frenck-Mestre, C. (1998). Masked priming by translation equivalents in proficient bilinguals. Language and Cognitive Processes, 13(6), 601-623.

Gray, T., & Kiran. S. (in press). A theoretical account of lexical semantic deficits in bilingual aphasia. Journal of Speech, Language, and Hearing Research.

Green, D. W. (1986). Control, activation, and resource: A framework and a model for the control of speech in bilinguals. Brain and Language, 27(2), 210-223.

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. Bilingualism: Language & Cognition, 1, 67-81.

Green, D. W., Grogan, A., Crinion, J., Ali, N., Sutton, C., & Price, C. J. (2010). Language control and parallel recovery of language in individuals with aphasia. Aphasiology, 24(2), 188-209. doi:10.1080/02687030902958316

Hermans, D., Bongaerts, T., de Bot, K., & Schreuder, R. (1998). Producing words in a foreign language: Can speakers prevent interference from their first language? Bilingualism: Language and Cognition, 1, 213-229.

Hinckley, J. J. (2003). Picture naming treatment in aphasia yields greater improvement in L1. Brain and Language, 87, 171-172.

Howard, D., & Patterson, K. (1992). Pyramids and Palm Trees. London, England: Harcourt Assessment.

Hsiao, E. Y., Schwartz, M. F., Schnur, T. T., & Dell, G. S. (2009). Temporal characteristics of semantic perseverations induced by blocked-cyclic picture naming. Brain and Language, 108(3), 133-144. doi:10.1016/j.bandl.2008.11.003

Jiang, N. (1999). Testing processing explanations for the asymmetry in masked cross-language priming. Bilingualism: Language and Cognition, 2, 59-75.

Junque, C., Vendrell, P., Vendrell-Brucet, J. M., & Tobena, A. (1989). Differential recovery in naming in bilingual aphasics. Brain and Language, 36(1), 16-22.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). Boston Naming Test. Philadelphia, PA: Lea and Febiger.

Kaushanskaya, M., & Marian, V. (2009). The bilingual advantage in novel word learning. Psychonomic Bulletin & Review, 16(4), 705-710. doi:10.3758/PBR.16.4.705

Kaushanskaya, M., & Rechtzigel, K. (2012). Concreteness effects in bilingual and monolingual word learning. Psychonomic Bulletin & Review, 19(5), 935-941. doi:10.3758/s13423-012-0271-5

Kiran, S. (2008). Typicality of inanimate category exemplars in aphasia treatment: Further evidence for semantic complexity. Journal ofSpeech, Language, and Hearing Research, 51, 15501568. doi:10.1044/1092-4388(2008/07-0038)

Kiran, S., & Bassetto, G. (2008). Evaluating the effectiveness of semantic-based treatment for naming deficits in aphasia: What works? Seminars in Speech and Language, 29(1), 71-82. doi:10.1055/s-2008-1061626

Kiran, S., & Johnson, L. (2008). Semantic complexity in treatment of naming deficits in aphasia: Evidence from well-defined categories. American Journal of Speech-Language Pathology, 17(4), 389-400. doi:10.1044/1058-0360(2008/06-0085)

Kiran, S., Pena, E., Bedore, L., & Sheng, L. (2010). Evaluating the relationship between category generation and language use and proficiency. Paper presented at the Donostia Workshop on Neurobilingualism, San Sebastian, Spain.

Kiran, S., & Roberts, P. M. (2010). Semantic feature analysis treatment in Spanish-English and French-English bilingual aphasia. Aphasiology, 24(2), 231-261.

Kiran, S., & Roberts, P. (2012). What do we know about assessing language impairment in bilingual aphasia? In M. Gitterman, M. Goral, & L. K. Obler (Eds.), Aspects of multilingual aphasia (pp. 35-51). Clevedon, UK: Multilingual Matters.

Kiran, S., & Sandberg, C. (2011). Treating communication problems in individuals with disordered language. In R. Peach & L. Shapiro (Eds.), Cognition and acquired language disorders: A process-oriented approach (pp. 298-326). London, England: Elselvier.

Kiran, S., Sandberg, C., & Abbott, K. (2009). Treatment for lexical retrieval using abstract and concrete words in patients with aphasia: Effect of complexity. Aphasiology. 23(7-8), 835-853.

Kiran, S., & Thompson, C. K. (2003). The role of semantic complexity in treatment of naming deficits: Training semantic categories in fluent aphasia by controlling exemplar typicality. Journal of Speech, Language, and Hearing Research, 46, 608-622.

Kohnert, K. (2004). Cognitive and cognate-based treatments for bilingual aphasia: A case study. Brain and Language, 91(3), 294-302.

Kroll, J. F., Bobb, S. C., Misra, M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. Acta Psychologica (Amsterdam), 128(3), 416-430. doi:S00016918(08)00022-X [pii] 10.1016/j.actpsy.2008.02.001

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connection between bilingual memory representations. Journal of Memory and Language, 33(2), 149-174.

Kroll, J. F., van Hell, J. G., Tokowicz, N., & Green, D. W. (2010). The revised hierarchical model: A critical review and assessment. Bilingualism, Language and Cognition, 13(3), 373-381. doi:10.1017/S136672891000009X

Laganaro, M., Di Pietro, M., & Schnider, A. (2006). What does recovery from anomia tell us about the underlying impairment: The case of similar anomic patterns and different recovery. Neuropsychologia, 44(4), 534-545.

Lorenzen, B., & Murray, L. L. (2008). Bilingual aphasia: A theoretical and clinical review. American Journal of Speech-Language Pathology, 17, 299-317.

Miertsch, B., Meisel, J. M., & Isel, F. (2009). Non-treated languages in aphasia therapy of polyglots benefit from improvement in the treated language. Journal of Neurolinguistics, 22(2), 135-150. doi:DOI 10.1016/j.jneuroling.2008.07.003

Miller Amberber, A. (2012). Language intervention in French English bilingual aphasia: Evidence of limited therapy transfer. Journal of Neurolinguistics, 25(6), 588-614.

Paradis, M. (1989). Bilingual Aphasia Test. Hillsdale, NJ: Erlbaum. Shin, H. B., & Kominski, R. A. (2010). Language use in the United States: 2007. Retrieved from http://www.census.gov/prod/2010pubs/acs-12.pdf.

Starreveld, P. A., & La Heij, W. (1995). Semantic interference, orthographic facilitation, and their interaction in naming tasks. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21, 686-698.

Williams, J. N. (1994). The relationship between word meanings in the first and second language: Evidence for a common, but restricted, semantic code. European Journal of Cognitive Psychology, 6(2), 195-220.

Swathi Kiran, (a,b) Chaleece Sandberg, (a) Teresa Gray, (a) Elsa Ascenso, (a) and Ellen Kester (c)

(a) Boston University, MA

(b) University of Texas at Austin

(c) Bilinguistics, Austin, TX

Correspondence to Swathi Kiran: kirans@bu.edu

Editor: Carol Scheffner Hammer

Associate Editor: Heather Wright

Received July 28, 2012

Revision received November 29, 2012

Accepted January 6, 2013

DOI: 10.1044/1058-0360(2013/12-0085)

(1) We conducted the Shapiro-Wilks test for normality on trained effect size data and the results showed that this assumption of normality was satisfied (Shapiro-Wilks W = .96117, p = .65360).

Table 1. Demographic information and Spanish and English diagnostic scores for all study participants. Part. Gender MPO Age at PPT BNT-E BNT-S BAT-Comp E testing UT07 F 6 56.1 DNT 23 18 80 UT23 F 3.5 41.5 90 0 2 63 BU07 F 7.5 65.2 52 0 15 7 UT19 M 50 75 75 3 47 17 UT16 F 16 56.11 75 5 5 63 UT01 M 8 53.8 DNT 0 0 38 UT11 F 9 53.1 DNT 8 5 52 UT09 F 6 87.9 DNT 57 10 97 UT18 F 30 73.8 77 28 32 67 UT22 M 3.5 41.4 83 5 47 57 BU01 M 84 44.7 92 37 43 70 BU04 M 173 37 94 58 12 70 UT02 F 9 54.1 90 43 40 78 UT17 M 11 53.7 87 52 8 82 BU12 F 5 33.3 100 0 0 42 UT20 F 41 85.6 71 0 0 DNT UT21 F 10 88 48 2 0 17 Part. BAT-Comp S BAT-Sem E BAT-Sem S BAT-Word Rec, E into S UT07 88 53 62 100 UT23 70 40 55 100 BU07 67 23 38 DNT UT19 75 DNT 32 40 UT16 60 75 48 100 UT01 15 28 40 20 UT11 45 23 15 100 UT09 75 67 42 DNT UT18 83 62 77 100 UT22 90 40 72 60 BU01 80 53 55 60 BU04 62 60 48 80 UT02 75 73 73 100 UT17 93 52 58 60 BU12 55 42 53 80 UT20 27 DNT 20 20 UT21 20 DNT DNT 0 Part. BAT-Word BAT-Tran, BAT-Tran, Rec, S into E E to S S to E UT07 100 5 10 UT23 100 0 0 BU07 DNT DNT DNT UT19 60 8 11 UT16 100 67 89 UT01 40 0 5 UT11 100 5 33.5 UT09 DNT DNT DNT UT18 80 95 61 UT22 80 8 13 BU01 80 49 60 BU04 100 0 36 UT02 100 30 31.5 UT17 100 43 61 BU12 100 0 0 UT20 60 0 0 UT21 0 0 0 Note. Part. = participant; UT = University of Texas; BU = Boston University; MPO = months post onset; PPT = Pyramids and Palm Trees (Howard & Patterson, 1992); BNT = Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983); E = English; S = Spanish; BAT = Bilingual Aphasia Test (Paradis, 1989); Comp = Comprehension; Sem = Semantics; Trans = Translation; BAT Comp E and BAT Comp S are averages from subtests: Pointing, Semi-Complex Commands, and Complex Commands; BAT-Sem E and BAT-Sem S are averages from subtests: Semantic Categories, Synonyms, Antonyms I and II, Semantic Acceptability, and Semantic Opposites; BAT-Trans E to S and BAT-Trans S to E are averages from subtests: Translation of Words and Translation of Sentences; DNT = Did not test. Table 2. Language history and language ratings across the two languages for all study participants. Part. AoA, E LE,E LE,S Conf, E Conf, S Poststroke CE, E UT07 0 DNT DNT DNT DNT DNT UT23 9.0 33 67 42 100 29 BU07 45.0 10 90 5 100 2 UT19 27.0 16 84 13 76 15 UT16 0 62 38 99 94 62 UT01 0 75 25 100 83 94 UT11 11.0 DNT DNT DNT DNT DNT UT09 5.0 DNT DNT DNT DNT DNT UT18 17.0 40 60 80 100 0 UT22 18.0 10 90 11 92 38 BU01 19.0 28 72 42 94 22 BU04 7.5 74 26 81 100 66 UT02 21.0 31 69 DNT DNT DNT UT17 6.0 66 34 96 98 55 BU12 12.0 28 72 54 100 46 UT20 69.0 5 95 2 100 12 UT21 5.0 72 28 100 100 99 Part. Poststroke Prestroke Prestroke Ed Hx, E Ed Hx, S CE, S LAR, E LAR, S UT07 DNT 94 31 100 0 UT23 71 66 94 22 78 BU07 98 32 100 0 100 UT19 85 20 100 0 100 UT16 38 94 74 67 33 UT01 6 100 40 100 0 UT11 DNT 98 100 DNT DNT UT09 DNT 100 82 100 0 UT18 100 100 100 25 75 UT22 63 34 94 0 100 BU01 78 89 89 0 100 BU04 34 100 49 100 0 UT02 DNT 90 100 DNT DNT UT17 45 100 100 58 42 BU12 54 80 100 28 72 UT20 88 DNT DNT 0 0 UT21 1 DNT DNT 100 0 Part. Fam Prof E Fam Prof, S Ave E Ave S UT07 DNT DNT 97 16 UT23 33 100 38 85 BU07 0 100 8 98 UT19 0 100 11 91 UT16 100 100 81 63 UT01 83 83 92 40 UT11 DNT DNT 98 100 UT09 DNT DNT 100 41 UT18 58 100 51 89 UT22 17 100 18 90 BU01 33 100 36 89 BU04 67 100 81 52 UT02 DNT DNT 60 85 UT17 75 100 75 70 BU12 65 100 50 83 UT20 0 100 4 77 UT21 100 100 94 46 Note. AoA = age of acquisition in years; LE = lifetime exposure; Conf = confidence; CE = current exposure; LAR = language ability rating; Ed = education; Hx = history; Fam = family; Prof = proficiency; Ave: average. All participants were native Spanish speakers so AoA of Spanish is 0 for everyone. Table 3. Treatment results for all study participants, including effect sizes for the trained language and the untrained language. Participant Number Language Trained Trained of items trained Language Language trained Set 1 Set 2 UT07 10 Spanish 12.41 0.94 UT23 15 Spanish 13.84 13.47 BU07 15 English 2.89 2.02 UT19 17 English 4.55 1.73 UT16 15 English 6.82 6.83 UT01 (a) 10 English 14.90 5.15 UT11 (a) 15 English 12.70 7.51 UT09 (a) 10 Spanish 10.97 2.64 UT18 15 Spanish 15.17 -0.29 UT22 15 Spanish 12.73 0.24 BU01 15 English 4.92 3.57 UT02 10 Spanish 11.08 6.36 BU04 10 Spanish 16.50 4.33 UT17 (a) 15 English 5.32 0.43 BU12 15 English 8.16 0.00 UT20 15 Spanish 0.00 0.00 UT21 15 English 0.00 -0.70 Participant Trained Untrained Untrained Untrained Language Language Language Language Set 3 Set 1 Set 2 Set 3 (Control) (Control) UT07 1.50 3.11 2.83 4.91 UT23 1.39 10.68 6.35 0.58 BU07 0.35 4.08 1.83 2.30 UT19 0.00 0.99 4.89 0.00 UT16 6.63 0.83 0.17 2.83 UT01 (a) 1.15 1.15 -0.58 -0.58 UT11 (a) 0.58 0.58 -0.58 -0.58 UT09 (a) 0.00 2.07 1.92 5.07 UT18 3.46 1.73 0.87 3.46 UT22 2.83 1.89 1.18 -1.41 BU01 1.57 1.42 2.28 1.28 UT02 2.12 4.95 6.84 2.12 BU04 0.83 2.52 2.39 0.61 UT17 (a) -5.43 1.19 -0.63 -0.56 BU12 0.00 0.00 0.00 0.00 UT20 0.00 0.00 0.00 0.00 UT21 0.00 0.00 0.00 0.00 (a) Indicates participants who underwent two phases of treatment (i.e., trained in both languages) and only effect size for the first phase is discussed in this paper. Table 4. Nonparametric Spearman correlation matrix for language impairment variables, averaged premorbid language use, AoA, and effect sizes for Trained Language Set 1. BAT-Comp PPT BNT-E BNT-S E PPT 1.00 0.37 0.09 0.52 BNT-E 1.00 0.49 ** 0.83 ** BNT-S 1.00 0.23 BAT-Comp E 1.00 BAT-Comp S BAT-Sem E BAT-Sem S Trained Language Set 1 Unrained Language Set 1 AoA, E Average English Composite Average Spanish Composite Trained BAT-Comp BAT-Sem BAT-Sem Language S E S Set 1 PPT 0.26 0.00 0.42 0.56 ** BNT-E 0.55 ** 0.61 ** 0.40 0.29 BNT-S 0.76 ** 0.28 0.43 0.27 BAT-Comp E 0.59 ** 0.70 ** 0.53 ** 0.32 BAT-Comp S 1.00 0.26 0.72 ** 0.30 BAT-Sem E 1.00 0.43 0.06 BAT-Sem S 1.00 0.56 ** Trained Language Set 1 1.00 Unrained Language Set 1 AoA, E Average English Composite Average Spanish Composite Untrained Average Average Language AoA, English Spanish Set 1 E Composite Composite PPT 0.33 -0.17 0.18 -0.08 BNT-E 0.38 -0.19 0.45 -0.17 BNT-S 0.52 ** 0.39 -0.27 0.43 BAT-Comp E 0.38 -0.30 0.40 -0.41 BAT-Comp S 0.52 ** 0.12 -0.14 0.18 BAT-Sem E 0.03 -0.20 0.26 -0.43 BAT-Sem S 0.42 -0.13 0.03 -0.13 Trained Language Set 1 0.44 -0.16 0.29 0.12 Unrained Language Set 1 1.00 0.06 -0.01 0.14 AoA, E 1.00 -0.81 ** 0.74 ** Average English Composite 1.00 -0.58 ** Average Spanish Composite 1.00 Note. AoA = age of acquisition in years. ** significant at p < .05.

Kiran, Swathi^Sandberg, Chaleece^Gray, Teresa^Ascenso, Elsa^Kester, Ellen

Source Citation (MLA 7th Edition)
Kiran, Swathi, et al. "Rehabilitation in bilingual aphasia: evidence for within- and between-language generalization." *American Journal of Speech-Language Pathology* 22.2 (2013): S298+. *Academic OneFile*. Web. 18 June 2015.

URL
http://go.galegroup.com/ps/i.do?id=GALE%7CA338601966&v=2.1&u=txshracd2598&it=r&p=AONE&sw=w&asid=31cf82d778db3e9ea7fac7fdb5e84e46

Gale Document Number: GALE|A338601966