The Efficacy of Semantic Feature Analysis for the Treatment of Aphasia: A Systematic Review

Abstract

Semantic feature analysis (SFA) is a common treatment for improving naming ability in persons with aphasia (PWA). To examine the effectiveness of SFA in improving naming abilities, we conducted an evidence-based systematic review. Seven studies met the inclusion criteria, were assigned appropriate levels of evidence, and were examined for methodological quality using the Single-Case Experimental Design (SCED) scale. Inter-rater reliability was established using Cohen's weighted kappa statistic. To determine the clinical significance of SFA, effect sizes, or percent of non-overlapping data (PND), were calculated. Results of this study indicate that SFA may be most effective for persons with fluent aphasias.

Introduction and Background

Semantic feature analysis (SFA) is a common treatment method used to improve naming abilities in persons with aphasia (PWA). SFA is hypothesized to improve the retrieval of conceptual information by accessing semantic networks (Chapey, 2001). In this technique, individuals are prompted to produce semantically similar words to the target word. Individuals are shown a picture of the target word to be named. If the individual has difficulty providing the correct name for the target, the individual is prompted to describe salient features, use, action and associations for the target word (Chapey, 2010). An example SFA chart used in therapy is displayed in Figure 1. Although SFA is widely used for the treatment of naming deficits in PWA, the efficacy of the treatment is unclear. The aim of the current study was to (a) determine the clinical efficacy of SFA in the treatment of aphasia and (b) evaluate the current state of evidence regarding SFA in the treatment of aphasia.

Method

To meet the aims of the review, a systematic search of the literature was conducted to identify studies that investigated SFA as the sole treatment intervention for anomia in PWA. Seven electronic databases were searched through December 2011: Academic Search Premier, AgeLine, CINAHL, ERIC, Medline, PyscInfo, and Linguistics and Language Behavior Abstracts. Additional searches were also performed on all American Speech Language and Hearing Association (ASHA) journals in addition to cross-referencing from other studies. Search terms included: *aphasia, semantic feature analysis, language disorder, semantic cues,* *anomia, language treatment* and *naming treatment.* The process of identifying articles to be included in the evidence-based systematic review (EBSR) is displayed in Figure 1.

Two certified speech-language pathologists critically evaluated the remaining seven studies for methodological quality using the Single-Case Experimental Design (SCED) scale (Tate et al., 2008). Following independent scoring, an average score was calculated to determine the SCED score. Inter-rater reliability was calculated using Cohen's weighted kappa statistic (Cohen, 1960). Like the kappa, the weighted kappa is the proportion of agreement beyond chance and takes into consideration the degree of disagreement between two independent raters. The weighted kappa score was .656, indicative of good inter-rater reliability (Altman, 1991). Each reviewer randomly reviewed three studies and re-calculated SCED scores in order to calculate intra-rater reliability. Point-to-point intra-rater reliability was 100%, indicating excellent intra-rater reliability.

It is well understood that clinical effectiveness is a critically important variable to consider for any treatment. At the same time, it is important to interpret clinical effectiveness in light of the quality of a given study. To strengthen interpretation of the results, we elected to also assign levels of evidence based on ASHA's levels-of-evidence hierarchy (ASHA, n.d.). Point-to-point inter-rater reliability was judged to be 100% for assigning appropriate levels of evidence.

To determine efficacy of SFA as a treatment method for PWA, effect sizes were calculated when adequate data was presented in the study. Effect sizes were calculated using a variation of Cohen's (1988) *d* statistic as described by Busk and Serlin (1992). To determine the magnitude of small, medium, and large effect sizes, we used the benchmarks for lexical retrieval studies as described by Robey & Beeson (2005). The benchmarks were 4.0, 7.0, and 10.1 for small, medium, and large effect sizes, respectively. When it was not possible to calculate the *d* statistic, the percent of non-overlapping data (PND) was calculated. The PND statistic is calculated as the percentage of treatment data points that do not overlap with baseline data points (Gast, 2010). The PND can range from 0 to 100. To determine the magnitude of effect, we used the benchmarks put forth by Scruggs et al. (1987). A PND greater than 90% reflects a highly effective treatment, a PND of 70-90% is considered a moderate treatment outcome, and a PND of less than 50% indicates unreliable or ineffective treatment.

Results

The seven studies included in the review were single-subject research design studies, and included a total of 16 participants. Variables of interest for participants are presented in Table 1.

Scores on the SCED ranged from 7.5 to 10.5 with an average score of 9.2 out of 11 (Table 2). Following SCED scoring, studies were also assigned levels of evidence based on ASHA's level of evidence hierarchy (ASHA, n.d). All studies received a level IIb rating and were deemed well-designed, quasi-experimental studies. The prevalence of high SCED scores and IIb evidence level ratings indicate strong methodological quality and rigor for the studies included.

Effect sizes and PND calculations are presented in Table 3, with interpretation of magnitude of effect, for all participants. Large effect sizes or highly effective PND result were present in 10 out of 22 trials, indicating that SFA treatment was highly effective in improving naming abilities for certain individuals. A moderately effective PND was present in 1 out of 22 trials, indicating that the treatment was moderately effective in improving naming abilities for one participant. A small or ineffective magnitude effect was present in 11 out of 22 trials, indicating that SFA treatment was not effective for a large portion of individuals. Post hoc analyses of the results indicate that the majority of trials with large effect sizes or highly effective PND results were for individuals who presented with fluent aphasias. Results indicate that SFA may be an effective treatment for certain individuals with aphasia, but not all.

Discussion

Results of this EBSR indicated that methodological sound research is being conducted to investigate the effectiveness of SFA, as evidenced by the high SCED scores. Moreover, results suggest that the effectiveness of SFA as treatment for anomia may be more effective for persons with fluent aphasias as compared to nonfluent. Consequently, clinicians considering SFA as a treatment may need to consider aphasia type. Though word-finding difficulties may be present in both fluent and nonfluent aphasias, the requirement to describe salient features of a target word may be more difficult for individuals with non-fluent aphasias. Previous research suggests that individuals with fluent aphasias demonstrate significant deficits in category knowledge (Shelton & Caramazza, 1996; Kiran & Thompson, 2003), so treatment to target category knowledge deficits may be more effective for this group.

It is important to keep in mind that SFA is not always conducted using a standardized procedure. For example, some studies included in the EBSR reported longer treatment periods while some included more frequent treatment sessions. Additionally, certain studies targeted atypical exemplars (e.g., egret), while others targeted more typical exemplars (e.g., robin). Standard execution of SFA would improve the capability to conduct meta-analysis to determine more conclusive evidence of effectiveness.

Additional research is clinically vital to our understanding of SFA treatment. These results suggest that SFA is more effective for some PWA as compared to others. It is important to further examine and determine which individuals may derive the most benefit from SFA as well as any other factors that could affect outcomes. This will permit clinicians to make more informed clinical decisions regarding the utility of SFA for a given individual.

References

Altman, D. (1991) *Practical statistics for medical research.* London: Chapman and Hall.

American Speech Language Hearing Association. (n.d.) *Levels of Evidence.* http://www.asha.org/members/ebp/assessing.htm

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

Boyle, M. (2004) Semantic feature analysis treatment for anomia in two fluent aphasia syndromes. *American Journal of Speech-Language Pathology, 13,* 236-249.

Boyle, M., & Coelho, C. (1995) Application of semantic feature analysis as a treatment for aphasic dysnomia. *American Journal of Speech-Language Pathology, 4,* 94-98.

Busk, P. L., & Serlin, R. C. (1992) Meta-analysis for single-case research. In T.R. Kratochwill & J.R. Levin (Eds.), *Single-case research design and analysis* (pp. 187-212). Hillsdale, NJ: Lawrence Erlbaum.

Chapey, R. (2001) *Language interventions strategies in aphasia and related neurogenic communication disorders.* (4th ed.) Baltimore: Lippincott Williams & Wilkins

Coelho, C., McHugh, R., & Boyle, M. (2000) Semantic feature analysis as a treatment for aphasic dysnomia: A replication. *Aphasiology, 14,* 133-142.

Cohen, J. (1960) A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20,* 37-46.

Cohen, J. (1988) *Statistical power analysis for the behavioral sciences (2nd ed.).* Hillsdale, NJ: Erlbaum.

Davis, L., & Stanton, S. (2005) Semantic feature analysis as a functional therapy tool. *Contemporary Issues in Communication Science and Disorders, 32,* 85-92.

Gast, D. (2010) *Single Subject Research Methodology in Behavioral Sciences.* New York: Routledge.

Kiran, S., & Thompson, C. (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 & Hearing Research, 46,* 773-787.

Lowell, S., Beeson, P., & Holland, A. (1995) Semantic cueing procedure on naming performance of adults with aphasia. *American Journal of Speech Language Pathology, 4,* 109-114.

Peach, R., & Reuter, K. (2010) A discourse-based approach to semantic feature analysis for the treatment of aphasic word retrieval failures. *Aphasiology, 24,* 971-990.

Rider, J., Wright, H., Marshall, R., & Page, J. (2008) Using semantic feature analysis to improve contextual discourse in adults with aphasia. *American Journal of Speech-Language Pathology, 17,* 161-172.

Rose, M., & Douglas, J. (2008) Treating a semantic word production deficit in aphasia with verbal and gesture methods. *Aphasiology, 22*(1), 20-41.

Scruggs, T., Mastropieri, M., & Casto, G. (1987) The quantitative synthesis of single-subject research: Methodology and validation. *Remedial and Special Education, 8,* 24-33.

Shelton, J. R., & Caramazza, A. (1996) Deficits in lexical and semantic processing: Implications for models for normal language. *Psychonomic Bulletin & Review, 6,* 5-27.

Tate, R., McDonald, K., Perdices, M., Togher, L., Schultz, R., & Savage, S. (2008) Rating the methodological quality of single-subject designs and *n*-of-1 trials: Introducing the Single-Case Experimental Design (SCED) Scale. *Neuropsychological Rehabilitation, 18*(4), 385-401.

Table 1. Participant demographic information

Study	*N*	Age (yrs)	Gender	Etiology	TPO (mos)	Aphasia Type	Aphasia Severity
Boyle (2004)	2	*M*=57	1 M 1 F	L CVA	12	1 nonfluent 1 fluent	NR
Coelho et al. (2000)	1	52	1 M	TBI	17	fluent	Moderate-severe
Davis & Stanton (2005)	1	59	1 F	CVA	4	fluent	NR
Kiran & Thompson (2003)	4	*M*=68.5	1 M 3 F	L CVA	*M*=33.75	4 fluent	NR
Lowell et al. (1995)	3	*M*=72	3 M	L CVA	*M*=18.33	2 nonfluent (conduction) 1 nonfluent (anomic)	Moderate Moderate
Peach & Reuter (2010)	2	*M*=69.5	2 F	L CVA	*M*=8	2 nonfluent (anomic)	1 Mild 1 Moderate
Rider et al. (2008)	3	*M*=63.3	2 M 1 F	CVA	*M*=66	3 nonfluent	NR

Note: NR=Not Reported; CVA=cerebrovascular accident; L=Left hemisphere; TPO=Time post onset

Table 2. Critical appraisal of the literature

Citation	Research Design	SCED Quality Score	ASHA Levels-of-Evidence Score
Boyle (2004)	multiple baseline design across behaviors	10.0	II b
Coelho et al. (2000)	A-B single subject	8.5	II b
Davis & Stanton (2005)	multiple baseline design across behaviors	8.0	II b
Kiran & Thompson (2003)	multiple baseline design across behaviors	10.0	II b
Lowell et al. (1995)	multiple baseline across behaviors	7.5	II b
Peach & Reuter (2010)	single-case time series design across behaviors	10.0	II b
Rider et al. (2008)	multiple probes across behaviors	10.5	II b

Table 3. Statistical analysis, PND, and magnitude of effect for individual studies

Citation	Participant / Set	Cohen's *d*	PND	Magnitude of Effect
Boyle (2004)	P1	18.48		Large
	P2		100%	Highly Effective
Coelho et al. (2000)	P1		100%	Highly Effective
Davis & Stanton (2005)	P1		91.67%	Highly Effective
Kiran & Thompson (2003)	P1	12.70		Large
	P2	13.59		Large
	P3	4.88		Small
	P4	11.59		Large
Lowell et al. (1995)	P1 - Set 1		100.00%	Highly Effective
	P1 - Set 2		100.00%	Highly Effective
	P2 -Set 1		87.50%	Moderately Effective
	P2 - Set 2		100.00%	Highly Effective
	P3 - Set 1		28.57%	Ineffective
	P3 - Set 2		14.29%	Ineffective
Peach & Reuter (2010)	P1	1.79		Small
	P2		85.00%	Moderately Effective
Rider et al. (2008)	P1 - Set 1		Unable to be calculated	
	P1 - Set 2	4.81		Small
	P1 - Set 3	2.91		Small
	P2 - Set 1	5.70		Small
	P2 - Set 2	4.02		Small
	P2 - Set 3	6.90		Small
	P3 - Set 1	2.26		Small
	P3 - Set 2	2.61		Small
	P3 - Set 3	4.04		Small

Figure 1. SFA chart used during treatment as used in Boyle (2003)

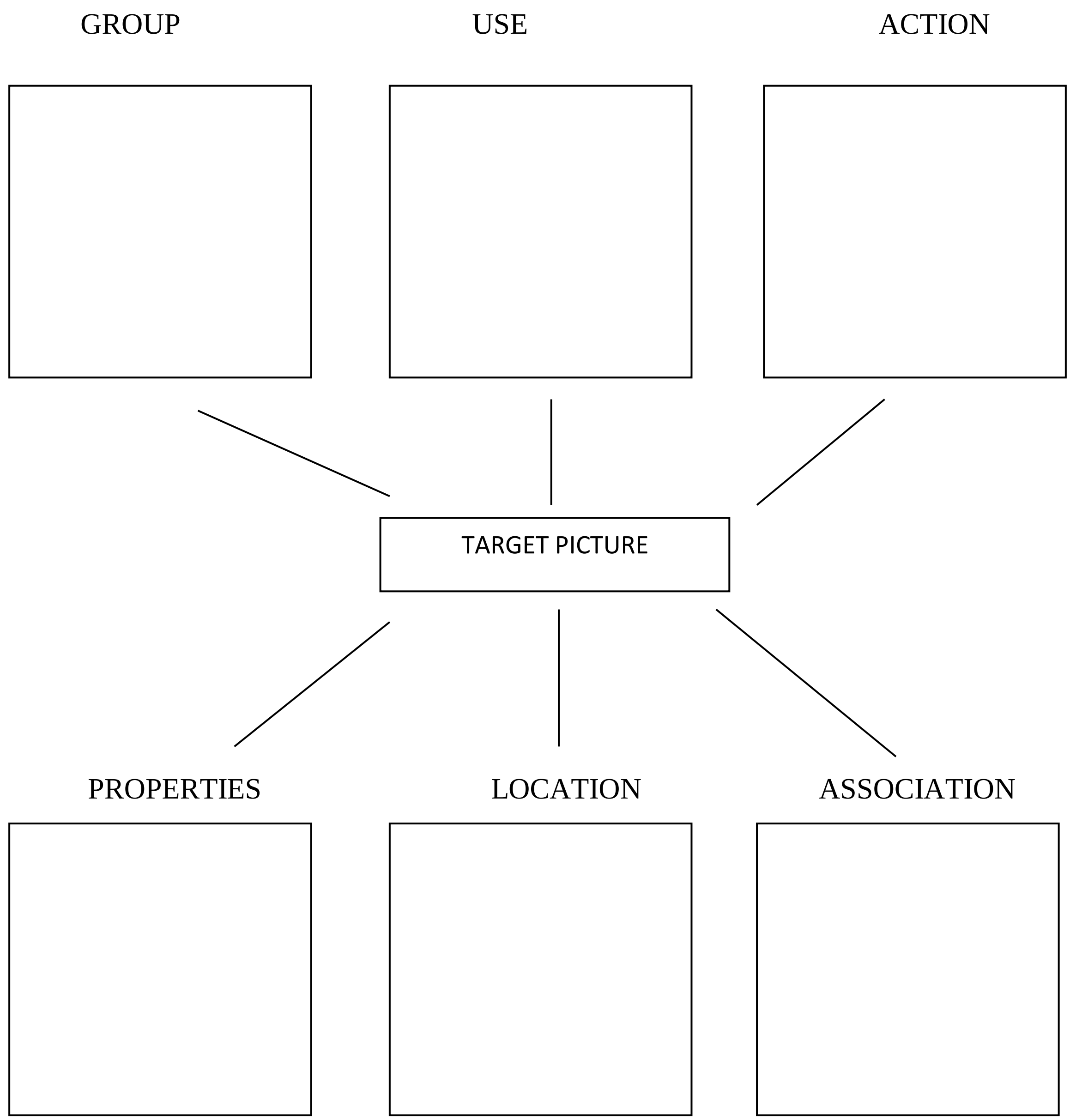

Figure 2. Process for identifying studies to be included in EBSR