Masked Priming Treatment for Anomia – A Phase 1 Study

Abstract

This Phase 1 single-subject study explored the use of masked repetition priming to improve word retrieval for picture naming in anomia. Masked priming is one means of activating the implicit language processes that typically support rapid, accurate use of language, and that may be impaired in aphasia. This study used computer-based presentation of masked primes repeatedly paired with pictures to encourage re-establishment of implicit language networks. Results from one participant show positive training effects, suggesting that masked primes may be an effective way to directly address repair or rebuilding of language networks in anomia.

Summary of Proposal

Introduction

Considerable evidence suggests that anomia is a result of lexical access deficits (e.g., Butterworth, 1992; Lambon Ralph, Sage, & Roberts, 2000; McNeil, Odell, & Tseng, 1991; Tseng, McNeil, & Milenkovic, 1993), such that linguistic representations remain but access to these representations is somehow hindered. This can be explained within the framework of an interactive two-step model of lexical retrieval (e.g., Dell, 1986), which suggests that linguistic information is processed in networks of nodes, or units of information. Each node has a resting level of activation that varies due to a variety of factors. Fluent language processing is the result of activation spreading between these nodes, allowing accurate selection of the appropriate units of information at the appropriate time. This spread of activation is automatic and implicit, operating outside of conscious control. In anomia, there is evidence that the processes of automatic spreading activation may be impaired or altered, leading to inefficient lexical retrieval (Prather, Zurif, Love, & Brownell, 1997; Silkes, 2009).

If, in fact, anomia involves impairment of automatic spreading activation, then it could be beneficial if anomia treatments were designed to re-establish these implicit processes. Previous research has suggested that *masked priming* may be one means by which this could be done. Masked priming is a process in which a target stimulus is preceded by a rapid presentation of a prime that is masked by other symbols. This allows the prime items to have a strictly implicit effect on the language system without the influence of explicit processes, such as strategizing (Ferrand, Humphreys, & Segui, 1998; Forster, 1998).

One single case study has been reported that measured the effects of masked repetition priming on picture naming in aphasia rehabilitation (Avila, Lambon Ralph, Parcet, Geffner, & Gonzalez-Darder, 2001). In this study, pictures were primed with a brief masked presentation of the printed names of the target images, so that the participant was unaware that a word had been presented. Results included a significant increase in naming accuracy and a decrease in response time (RT) for pictures preceded by masked primes in comparison to unprimed pictures. This study (Avila, et al., 2001) provided initial data to suggest that masked priming might be an effective method for rehabilitation in anomia. The study left questions, however, regarding the generalizability of results to other individuals with aphasia, as well as potential long-term effects of training using this method.

This Phase 1 study was undertaken to determine if repeated exposure to masked repetition priming would improve lexical retrieval abilities in individuals with aphasia. In the context of a single subject multiple baseline design, training was delivered with repeated probe testing before, during and after training to measure acquisition, maintenance and generalization effects of masked priming training.

At this time, data have been collected and analyzed for a single participant, reported here. These findings will be replicated in a second participant, with data collection planned for February and March 2012.

Method

Participant

Participant #1 was a 52-year-old male with moderate-severe non-fluent aphasia. He initially scored an Aphasia Quotient of 70/100 on the Western Aphasia Battery (Kertesz, 1982), and 33/60 on the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983). He demonstrated significant phonological processing impairments on the Standardized Assessment of Phonology in Aphasia (Kendall, et al., 2010). In response to seven open-ended conversational discourse questions (Altmann, Kempler, & Andersen, 2001), he produced 56 words, with a type-token ration of 39.3% and 5 unique nouns. He had no dysarthria, but had mild apraxia of speech (AOS; 42/50 on the Apraxia Battery for Adults; Dabul, 2000). He had no significant depression as rated on the Depression Intensity Scale Circles (Turner-Stokes, Kalmus, Hirani, & Clegg, 2005), and did not report any history of drug or alcohol abuse or other speech-language disorders.

Stimuli

Training stimuli were 40 color photographs of monomorphemic nouns, representing two semantic categories (*animals* and *things to wear*). They were divided into trained and untrained items for each category. Lists were roughly matched in terms of frequency, typicality, phonologic neighborhood density, phonotactic probability, imageability, familiarity, number of syllables, age of acquisition and concreteness.

Training protocol

Ten training sessions occurred for one semantic category, and 12 for the second. All stimuli were presented on a computer screen in a quiet room. Training involved repeated exposure to masked repetition primes (the picture names) and target pictures, with several presentations before asking for a naming response. The protocol was designed to allow implicit pairing of target names and pictures through automatic spreading activation prior to asking for retrieval of the lexical items. Each trial involved four pairings of the prime and target, as follows (and see Figure 1):

- Forward mask of 12 hash marks (############)
- Prime word (or XG string for untrained words)
- Backward mask identical to forward mask
- Blank screen (prime-target interval)
- Target picture

This sequence was repeated four times consecutively. The target picture was presented for 1,000 msec in the first three of four presentations of the sequence, with no response required. On the fourth presentation, it was presented for 10,000 msec and framed in green to signify the response interval. No feedback was provided at any time during training.

Outcome measures and analysis

The primary outcome measure was accuracy of confrontation naming for trained and untrained nouns. Probes were administered multiple times prior to the start of treatment of each category, were continued after every two treatment sessions during the training period, and again multiple times immediately after treatment termination. Repeated probe data were scored on-line for accuracy and digitally recorded for reliability. Inter- and intra-rater reliability was performed on 25% of the repeated probe data. To assess generalization to broader language skills, the WAB, BNT, and conversational discourse questions were administered again following treatment termination.

Results

Inter-rater reliability was high, with Chronbach's alpha = .984. Intra-rater reliability was high, with Chronbach's alpha = .972.

Participant #1 showed a small effect size for improved naming of trained items in both categories (animals: ES = 2.10; things to wear: ES = 3.48), but not on untrained items (animals: ES = 1.36; things to wear: ES = 0.79) that had received equal exposure. A small effect size was noted for cross-category generalization (ES = 3.61) (see Figure 2). In addition to changes on naming probes, this participant's WAB AQ and responses to the conversational discourse questions improved (see Table 1 for summary of scores). There was no change noted in the non-linguistic control task (ES = 0.23).

Discussion

Data from one participant in this Phase 1 treatment study provide preliminary support for the use of masked priming as a novel treatment methodology for anomia. Because the prime words were masked, and therefore not available for conscious processing, training effects appear to have been mediated solely through implicit mechanisms. Presumably, due to repeated pairing of prime words and target pictures, network connections were strengthened through Hebbian learning (Hebb, 1949). This echoes the mechanism by which the linguistic network is originally developed and refined, and reinforces the mechanisms that allow rapid, accurate use of language in the unimpaired, non-aphasic system. Further development of this novel methodology for anomia treatment is needed to maximize its potential for directly treating the implicit language processing system in aphasia.

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Figure 1 - Sequence of visual stimuli for a single trial. All stimuli were presented centered on a computer screen. Stimulus exposure durations were designed to be precise given the limits of the computer monitor's 75 Hz refresh rate.

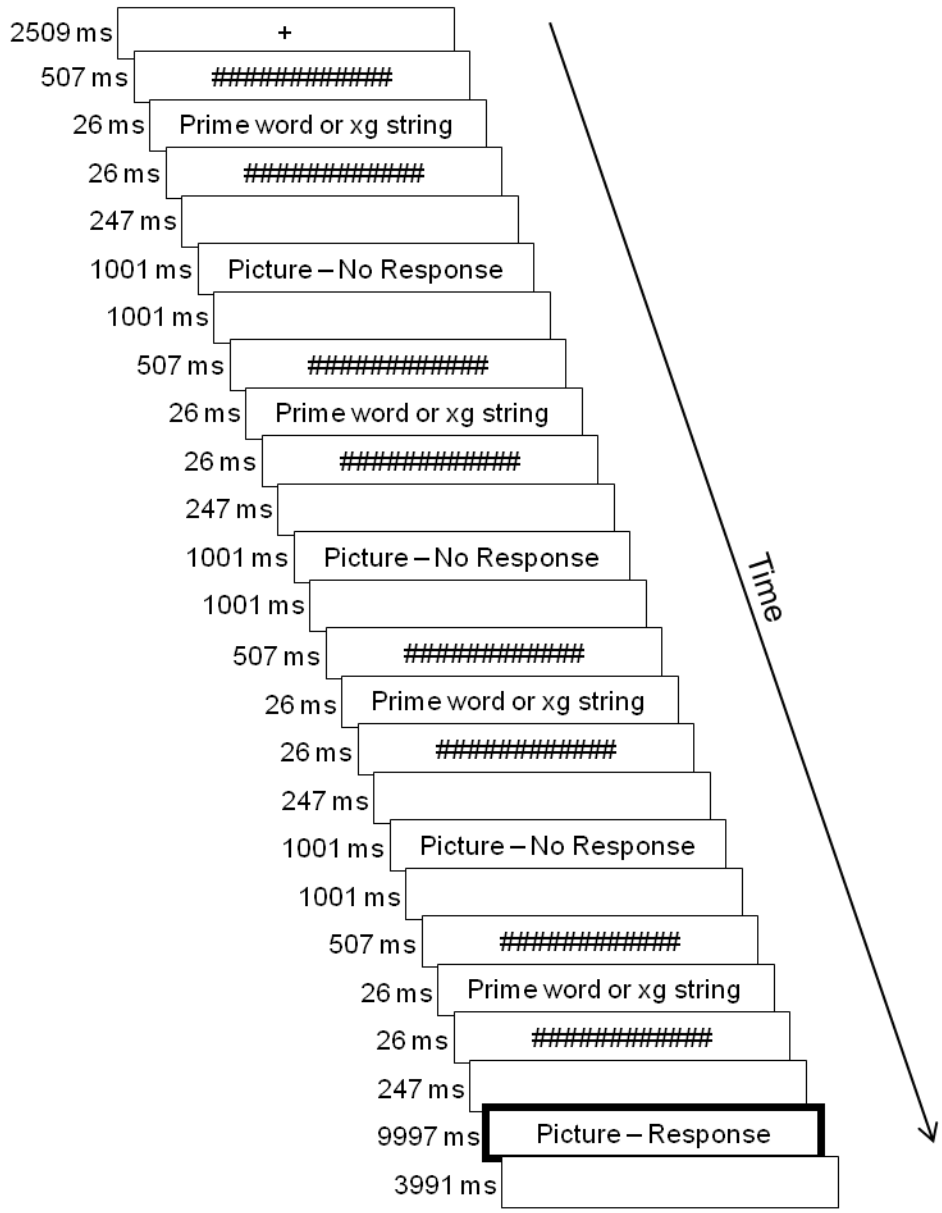

Figure 2 – Repeated probe data for Participant #1

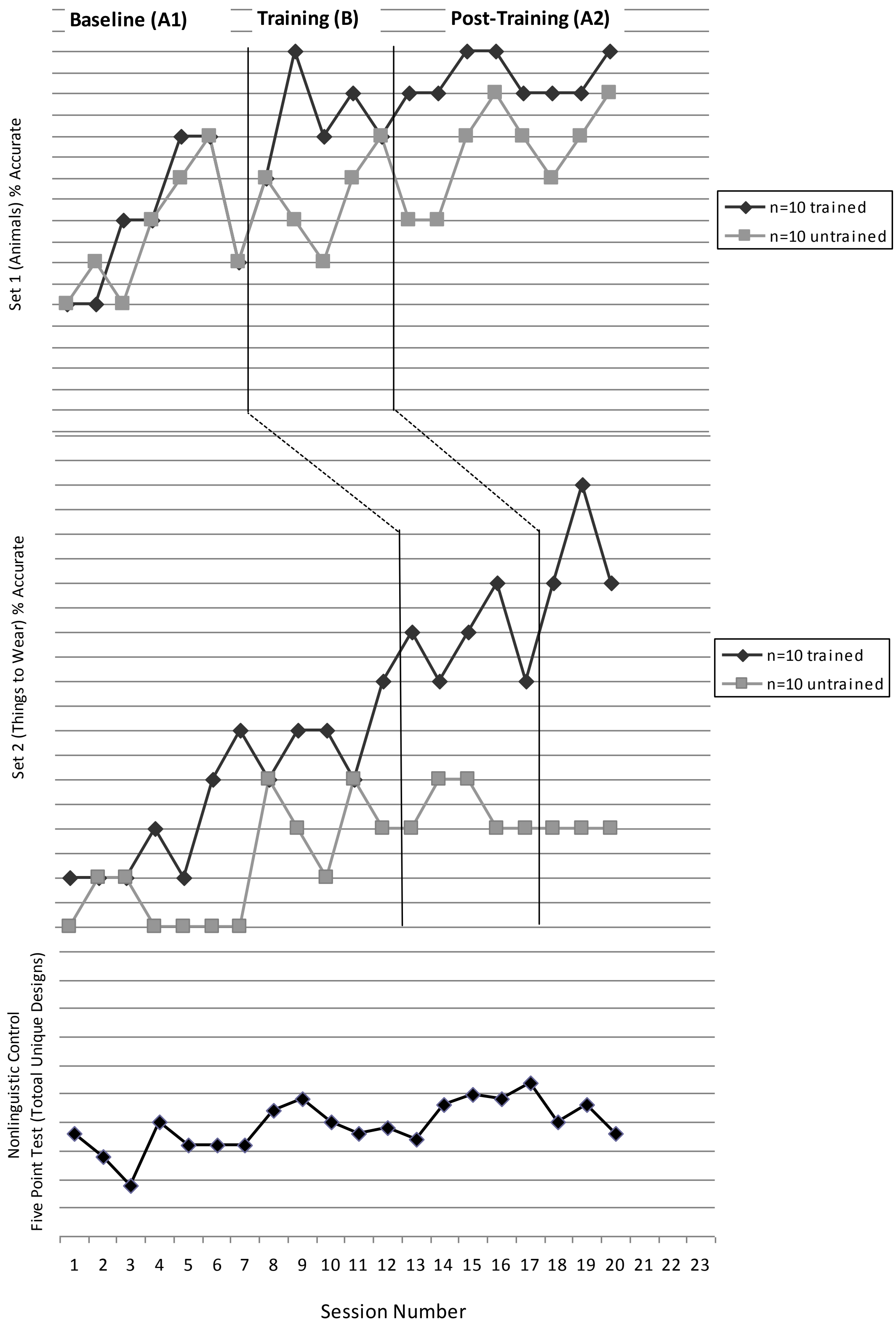

Table 1

Pre- and post-training test scores for Participant #1

Test	**Subtest**	**Pre-Training Score**	**Post-Training Score**
Western Aphasia Battery (WAB)	Information content (10)	6	8
	Fluency (10)	2	2
	Auditory yes/no questions (60)	45	54
	Auditory word recognition (60)	47	55
	Sequential auditory commands (80)	39	45
	Repetition (100)	53	56
	Object naming (60)	50	50
	Word fluency (20)	8	8
	Sentence completion (10)	8	8
	Responsive speech (10)	4	6
	Aphasia Quotient (100)	53	71
Boston Naming Test (BNT) (60)		33	34
Conversational Discourse Questions (CDQ’s)	Total number of words spoken	56	50
	Type-token ratio	39.3%	58%
	Total number of unique nouns	5	12