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# Effect of Positive and Negative Emotion on Naming Accuracy in Adults with Aphasia

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Effect of Positive and Negative Emotion on Naming Accuracy in Adults with Aphasia

Courtney Paige Nielsen

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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ABSTRACT

Effect of Positive and Negative Emotion on Naming Accuracy in Adults with Aphasia

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Master of Science

This is a preliminary study investigating the effects of emotion on a confrontational naming task in people with aphasia (PWA). Previous research investigating the effects of emotion on various language tasks in PWA has produced mixed findings with some suggesting a facilitative effect and others an inhibitory effect. Participants included 9 adults with aphasia as the result of a stroke, resulting in the presence of word-finding deficits (i.e., anomia). Participants named images in positive, negative, and neutral conditions. Responses were scored as either correct or incorrect; incorrect responses were coded further to illustrate individual error patterns. The majority of participants demonstrated a decrease in naming accuracy in the negative condition compared to the preceding and subsequent neutral conditions. The results of this study suggest that negative emotional arousal may cause PWA to devote attentional resources to emotional regulation and away from the linguistic task, thus interfering with language performance. Further research is needed to support these preliminary findings.

ACKNOWLEDGMENTS

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DESCRIPTION OF THESIS STRUCTURE AND CONTENT

This thesis, *Effect of Positive and Negative Emotion on Naming Accuracy in Adults with Aphasia,* is part of a larger study exploring the effect of emotion during a confrontational naming task for PWA. Portions of this thesis may be submitted for publication, with the thesis author being included in the list of contributing coauthors. The annotated bibliography is included in Appendix A, Institutional Review Board approved consent forms used in the study are provided in Appendix B, Self-Assessment Manikin arousal and pleasure ratings are provided in Appendix C, a list of stimuli for each condition is provided in Appendix D, and individual participant accuracy graphs are provided in Appendix E.

## Introduction

Aphasia is an acquired neurogenic communication disorder currently affecting over two million people in the United States (Simmons-Mackie & Cherney, 2018). People with aphasia (PWA) experience unique and varying levels of impairment in language expression and verbal comprehension as the result of damage to the left hemisphere of the brain. Word-finding difficulty (i.e., anomia) is characteristic among the aphasia population, with individual word-finding deficits ranging from mild to severe. Even mild naming deficits can have a negative impact on communicative functioning (Goodglass & Wingfield, 1997). Poor word-finding can discourage participation in life activities and ultimately result in social isolation (Cahana-Amitay et al., 2015). Despite language impairments, other cognitive functions (e.g., intelligence, memory, and visual-spatial abilities) often remain relatively intact. Furthermore, people with aphasia continue to understand, experience, and express emotion well, possibly because their right cerebral hemisphere—responsible for emotion processing—is preserved (Ross & Mesulam, 1979). The present study aims to investigate whether emotional arousal facilitates naming accuracy on confrontational naming tasks for people with aphasia.

## Emotion and Language Processing in Aphasia

People with aphasia demonstrate varying levels of impairment in their expressive and receptive language abilities. One of the most pervasive core deficits across all types of aphasia is anomia (Nickels, 2002), which is characterized by the inability to retrieve and verbally produce the appropriate word (Benson, 1988). Naming abilities are often evaluated and trained using confrontational naming tasks where the patient is asked to produce the word corresponding with an object or action presented visually. The basic process of naming is completed in the following three steps: (a) identification of the represented item; (b) access to the semantic representation of

the item, allowing it to be recognized; and (c) activation of its phonological representation for verbal naming of the picture or object (Spezzano & Radanovic, 2010). Deficits related to confrontational naming tasks are critical to observe and report during aphasia assessment (Goodglass, Kaplan, & Weintraub, 1983; Kertesz, 2006) and often warrant training during behavioral intervention (Boyle, 2004; Edmonds & Babb, 2011).

Beyond deficits, clinicians often note areas of relative strength within patient performance in order to determine possible treatment approaches with the goal of using intact abilities to facilitate language recovery (Reuterskiold, 1991). Due to hemispheric specialization and the role of the right hemisphere in processing emotions (Lorch, Borod, & Koff, 1998), people with aphasia usually demonstrate intact emotion expression (e.g., affect, pragmatics, and social communication). Emotion may also facilitate broad cognitive processes related to memory and language (Boller, Cole, Vrtunski, Patterson, & Kim, 1979; Czimskey & Marquardt, 2018; Lorch et al., 1998). Anecdotally, people with severe aphasia have been reported to produce emotionally charged words, such as expletives, with less effort than non-emotional words (Jackson, 1868; Landis, Graves, & Goodglass, 1982), but the effects of emotion on naming in aphasia have not been investigated empirically. The current study will consider the effect of emotion during a confrontational naming task. As we better understand the role of emotion processing in confrontational naming tasks, therapy approaches can more effectively target improved naming, leading to better maintenance and improved task generalization.

Although the effect of emotion on confrontational naming has not been investigated, previous reports suggest that emotional content may facilitate reading and writing, auditory comprehension, and repetition for people with aphasia due to the relationships between emotion and right hemisphere activation (Berrin-Wasserman, Winnick, & Borod, 2003; Bloom, Borod,

Obler, & Gerstman, 1993; Landis et al., 1982; Lorch et al., 1998; Ramsberger, 1996; Reuterskiold, 1991). In relation to reading and writing, Landis et al. (1982) investigated the effects of emotional stimuli on language processing in 32 participants with unilateral brain damage. The participants completed oral reading and writing tasks with stimuli consisting of emotional abstract, non-emotional abstract, and non-emotional concrete words, which were controlled for frequency of occurrence. People with aphasia both read and wrote emotional words more accurately than non-emotional words. Rueterskiold (1991) later investigated the effects of emotionality on an auditory word discrimination task where 12 participants with aphasia viewed a set of seven images and were asked to select the image depicting the target word, which was presented orally by a live examiner sitting directly across from the participant. Participants comprehended high emotion target words with increased speed and accuracy compared to neutral words. The author concluded that performance on language processing tasks is facilitated by emotionality of stimuli for people with aphasia. Ramsberger (1996) further supported previous findings about the facilitative effect of emotion by investigating the effects of emotion on a repetition task. Twenty participants repeated a total of 44 words presented via video-recording. Findings suggested that, compared to neutral words, emotion words elicited overall improved repetition.

While several studies have shown that emotionality may affect performance on language tasks for people with aphasia, most have considered emotional arousal with no regard to valence. When referring to emotions, *arousal* describes intensity or strength while *valence* describes direction (i.e., positive, negative). Ramsberger (1996) addressed valence by including both positive and negative emotion and non-emotion words in order to investigate possible effects of both valence and arousal on repetition performance. This study concluded that improved

repetition was the result of emotional arousal while valence did not have an effect on task performance. Compared with repetition, confrontational naming, requires higher levels of linguistic processing and is more ecologically valid. It is possible that valence may have no effect on linguistic processing, but with limited data, we are unable to discount the possibility entirely.

Research to date suggests that emotional content may have a facilitative effect on various language tasks in aphasia; however, findings are not without limitations. For example, Landis et al. (1982) controlled for length of stimuli and reported on frequency of occurrence but disregarded possible confounding linguistic variables (e.g., familiarity, imageability). Additionally, while these authors did not report on the effects of valence, the majority (11/12) of the stimulus words were negative (e.g., fear, dead, pain, and rage). Stimulus development continued to ignore possible confounding variables through the use of non-controlled word lists for target selection, where words were chosen seemingly at random without reference to previous research findings (Rueterskiold, 1991). Emotionality of stimuli was determined through independent rankings where emotion and non-emotion words were selected based on 7-point ratings of general emotionality without considering both valence and arousal (Ramsberger, 1996; Reuterskiold, 1991). In addition, the experimental procedure of these studies did not account for possible carryover effects (i.e., one condition influencing subsequent performance). A blocked design with a waiting period between conditions may reduce possible carryover effects. The present study aimed to address these possible confounding variables more thoroughly, while investigating the effects of emotion on performance during a confrontational naming task for people with aphasia.

**Possible Outcomes Based on Current Research**

Three hypotheses have been proposed that might account for the effects of emotion on language processing in aphasia: Right Hemisphere Hypothesis (RHH), Valence Specific Hypothesis (VSH), and Distraction Theory (DT; DeCaro, Thomas, Albert, & Beilock, 2011; Hielscher-Fastabend, 2015; Landis, 2006). The Right Hemisphere Hypothesis suggests that the right hemisphere is the dominant cortical structure for all emotion processing (Gainotti, 1999). Studies investigating the effects of emotion on various communication tasks in people with aphasia and, thus, left-hemisphere damage, provide evidence to support right hemisphere dominance in processing emotional information (Bloom et al., 1993; Landis, 2006; Lorch et al., 1998). Bloom et al. (1993) investigated the performance of nine individuals with unilateral right hemisphere brain damage, 12 with unilateral left hemisphere brain damage, and 12 neurotypically healthy adults on a discourse production task. Participants were instructed to view and describe three sets of sequential images that were designed with either emotional or non-emotional content. Group and individual results showed that people with left hemisphere brain damage were significantly more impaired for non-emotional content than in the emotional condition. Landis (2006) noted improved performance on writing and verbal production of emotion words compared to non-emotion words for people with aphasia, pointing to a right hemispheric participation in emotional word processing. Lorch et al. (1998) provided behavioral evidence suggesting that emotions, emotional information, and pragmatic language are all supported by right hemisphere processing. If the RHH holds true for the present study, people with aphasia will name both positive and negative words more accurately than neutral words due to the role of the right cerebrum in processing emotion.

In contrast, the VSH suggests that each cerebral hemisphere is specialized for particular emotion processes; the left cortical hemisphere plays a central role in processing positive emotions while the right hemisphere is specialized in processing negative emotions (Gainotti, 1999; Hielscher-Fastabend, 2015). Evidence for an effect of valence on linguistic performance in aphasia research has been minimal thus far; however, some research investigating the effects of emotionality on linguistic processing tasks among neurotypical adults provides support for the VSH (Duda & Brown, 1984). If the right hemisphere is in fact specialized in processing negative but not positive emotions, results of the present study would show that participants with aphasia name negative emotion words more accurately than neutral or positive words.

In direct contrast to the idea of emotion facilitating language, the DT posits that emotional arousal can interfere with cognitive processing by diverting attentional resources to emotion regulation. This hypothesis, therefore, would suggest that emotional stimuli (both positive and negative emotion words) might interfere with naming accuracy in people with aphasia (DeCaro et al., 2011). While no aphasia-specific evidence substantiates this theory, neurologically healthy adults have been shown to respond more slowly for emotional words, regardless of valence, compared to neutral stimuli (Blackett, Harnish, Lundine, Zezinka, & Healy, 2017). These findings suggest that emotional arousal may result in a disengagement of attentional resources prior to completion of the linguistic task. While accuracy has not been investigated in relation to DT, this theory predicts that emotional content may decrease naming accuracy.

In summary, we hypothesize that high arousal emotional stimuli will have a facilitative effect on naming accuracy for people with aphasia, regardless of valence, consistent with the RHH and previous behavioral research (Bloom et al., 1993; Gainotti, 1999; Landis, 2006; Lorch

et al., 1998); however, with a paucity of research and mixed findings in the limited reports available, the present study may ultimately support an alternative hypothesis (e.g., VSH and DT).

**Purpose of the Present Study**

The purpose of the present study is to investigate the effect of valence and arousal on naming accuracy on a confrontational naming task for people with aphasia. This research will contribute to the growing literature on the effects of emotion on naming accuracy. Understanding how emotion affects naming may also guide future intervention approaches, leading to improved naming accuracy and expressive language for people with aphasia. The following research questions will be addressed:

1. Does emotional arousal affect naming accuracy in a confrontational naming task for people with aphasia?

2. Does valence affect individual performance on a confrontational naming task for people with aphasia?

<div align="center">

**Method**

</div>

This thesis is part of a larger research project investigating the effect of emotion on confrontational naming tasks in people with aphasia. This study involves the analysis of naming accuracy on a confrontational naming task under different emotional conditions in people with aphasia using an ABACA case series design. Participants, experimental setting, stimulus development, experimental procedures, and measures are discussed.

**Participants**

Nine individuals with aphasia were recruited for participation in the study. All participants were over the age of 18, had aphasia as the result of left hemisphere brain damage, were at least 6 months post onset, and presented with current word-finding deficits as evidenced

by a score of less than 13 on the Boston Naming Test-short form (BNT-short form; Goodglass et al., 1983). Participant demographic and assessment information is listed in Table 1. Participants were recruited from the BYU Stroke and Brain Injury Registry and referrals from local clinicians.

Table 1

*Participant Demographic and Assessment Information*

| PptID | Sex | Age | TPO (yy;mm) | WAB-AQ | WAB Type | TEA 6 | TEA 7 | BNT % Correct |
|-------|-----|-----|-------------|--------|----------|-------|-------|---------------|
| AE01 | M | 52 | 6;01 | 81.8 | Anomic | 4.74 | 9.83 | 80 |
| AE02 | M | 62 | 9;00 | 34.2 | Broca's | 9.25 | 190.93 | 20 |
| AE03 | F | 64 | 7;07 | 62.0 | Broca's | 6.45 | 4.07 | 27 |
| AE04 | M | 76 | 3;01 | 60.3 | Wernicke's | 6.00 | 2.56 | 60 |
| AE05 | F | 40 | 1;01 | 83.4 | Anomic | 3.60 | 7.30 | 80 |
| AE06 | M | 42 | 6;06 | 85.9 | Anomic | 5.40 | 10.10 | 73 |
| AE08 | M | 58 | 14;10 | 66.0 | Broca's | 5.30 | 13.33 | 27 |
| AE09 | F | 48 | 16;04 | 68.8 | Broca's | 5.10 | 13.00 | 80 |
| AE10 | M | 34 | 5;11 | 63.2 | Broca's | - | - | 20 |

*Note.* TPO = Time Post-onset of aphasia; WAB-AQ = Aphasia Quotient on the Western Aphasia Battery Revised; TEA 6 = Test of Everyday Attention Subtest 6; TEA 7 = Test of Everyday Attention Subtest 7; BNT = Boston Naming Test

**Setting**

Participants chose whether to complete the study in their home, on BYU campus, or in a community space. Participation at BYU was conducted in the John Taylor Building (room 111). Time and location of assessment occurred according to participant preference and availability. Efforts were made to reduce environmental distractions during data collection sessions. Each session was audio-video recorded using a Canon Vixia HF R80 or HF R21camera with a Sony ECM-AW4 microphone. Participants were seated at a table to view picture stimuli displayed on a MacBook Pro via Microsoft PowerPoint version 16.16.22.

**Stimulus Development**

Positive, negative, and neutral pictures were selected from a previously reported wordlist that was rated for valence and arousal (Warriner, Kyperman, & Brysbaert, 2013). Consistent with previous research, words with arousal ratings of 5 or more (max = 9) and valence ratings of 6 or more (max = 9) were categorized as high arousal, positive; words with arousal ratings of 5 or more and valence ratings of 4 or less were considered high arousal, negative; words with arousal ratings of 3.2 or less and valence ratings between 4 and 6 were classified as low arousal, neutral (Bauerly & Paxton, 2017; Blackett et al., 2017). An arousal rating below 3.2 for neutral words was used in order to expand the potential targets to achieve control across all word lists.

Simple black and white images were assigned to words to be used for naming. Images were obtained from the International Picture-Naming Project (IPNP; Szekely et al., 2004) and royalty free clip art websites (www.vectorportal.com and www.clipart-library.com). Young adults were presented the images and asked to name each image using one word. Some images were modified to indicate the target word (e.g., arrow added to specific detail in the image). Images that were consistently named accurately during informal testing were included in a list of potential items to use in the experiment. Target words associated with these images were controlled for concreteness, familiarity, imageability, frequency, and articulatory complexity. Concreteness, familiarity, and imageability ratings were obtained from the Medical Research Council (MRC) Psycholinguistic Database (Coltheart, 1981) or, when not available through this database, from the Bristol norms (Stadthagen-Gonzales & Davis, 2006) or 40,000 English word lemmas (Brysbaert, Warriner, & Kuperman, 2014) lists. Any words that were not rated for these three variables were excluded from consideration. Frequency ratings were obtained using the Brigham Young University iWeb corpus (Davies, 2018). Articulatory complexity was calculated

using the Word Complexity Measure (Stoel-Gammon, 2010). The final word lists were arranged into five lists (1 positive, 1 negative, 3 neutral) that were each comprised of 20 target words. ANOVAs revealed no statistically significant difference between word lists in ratings of concreteness, familiarity, imageability, frequency, or articulatory complexity ($p > .05$). Table 2 reports means and standard deviations across the five word lists used in the study.

Table 2

*M (SD) of Linguistic Variables for Stimulus Word Lists*

| Stimulus List | Arousal | Valence | Concreteness | Familiarity | Imageability | Frequency | Articulatory Complexity |
|---|---|---|---|---|---|---|---|
| Neutral 1 | 2.88 | 5.36 | 585.75 | 533.15 | 564.35 | 391989.41 | 2.85 |
| | (0.22) | (0.43) | (37.08) | (62.86) | (38.42) | (603109.66) | (1.18) |
| Positive | 5.58 | 7.09 | 554.00 | 547.90 | 595.80 | 909363.45 | 3.20 |
| | (0.56) | (0.50) | (51.16) | (62.88) | (40.33) | (1158113.50) | (1.54) |
| Neutral 2 | 2.75 | 5.28 | 589.80 | 536.40 | 581.45 | 436696.50 | 3.20 |
| | (0.27) | (0.40) | (25.63) | (51.45) | (33.68) | (544593.85) | (1.70) |
| Negative | 5.87 | 3.18 | 554.90 | 524.15 | 579.70 | 276645.90 | 3.35 |
| | (0.74) | (0.50) | (100.43) | (42.02) | (46.99) | (364062.25) | (1.66) |
| Neutral 3 | 2.89 | 5.24 | 589.65 | 530.70 | 582.75 | 356087.15 | 2.95 |
| | (0.24) | (0.42) | (30.87) | (58.39) | (30.53) | (576639.78) | (1.57) |

**Procedures**

This study was approved by the BYU Institutional Review Board (IRB). Prior to participation in the study all participants provided informed consent. Each session was conducted in two phases: Pre-experimental evaluation and experimental session.

**Pre-experimental evaluation.** Prior to the experiment, all participants completed a series of assessments and questionnaires that were used to (a) determine eligibility and (b) describe speech, language, and mood. As part of the pre-experimental evaluation, participants completed hearing and vision screenings, Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986), Digital-Visual Analogue Mood Scale (D-VAMS; Barrows & Thomas, 2017), Western Aphasia Battery – Revised (WAB-R; Kertesz, 2006), the Boston Naming Test (BNT; Goodglass et al., 1983), and the Test of Everyday Attention – subtests 6 and 7 (TEA; Robertson, Ward, Ridgeway, & Nimmo-Smith, 1996).

The consent form for participants with aphasia was prepared to facilitate comprehension through bolding of key words and supplemental pictures. Each participant was given a copy of the consent form for thorough review. Administrators were trained to highlight key points of the form by rephrasing and summarizing content and asking questions to ensure comprehension. Following consent, each participant completed a vision and hearing screening. Hearing in both ears was screened at 40dB at the following frequencies: 500Hz, 1000Hz, 2000Hz, and 4000Hz. The Geriatric Depression Scale (GDS) and the D-VAMS were used to evaluate mood. The WAB-R and BNT were used to evaluate language functioning. Results from the TEA (subtest 7) were used to evaluate sustained attention.

**Experimental session.** After completing the pre-experimental evaluation, participants who met inclusion criteria began the experimental session. During this experimental session, participants completed a confrontational naming task under positive, negative, and neutral conditions. Participants were instructed to name target images as quickly and accurately as possible. They were encouraged to respond using a single word. Within each condition, participants viewed two colored images for six seconds each, before the presentation of a single

black and white image. Participants were instructed to look at the colored images for their full duration, but not to name these pictures. Colored pictures were selected from the Open Affective Standardized Image Set (OASIS) and are intended to reinforce the emotion of the items named within each condition (Bauerly & Paxton, 2017; Kurdi, Lozano, & Banaji, 2017). The black and white target images were presented for up to 30 seconds (Khatoonabadi et al., 2015). An accompanying tone presented at 1000 Hz for 500 ms sounded prior to the black and white target images, which match the emotional arousal and valence of the colored images and represent words that were previously controlled for concreteness, familiarity, imageability, frequency, and articulatory complexity. Following the first complete attempt to name each image, the target word was provided verbally before proceeding to the next image in an attempt to decrease possible perseverative rumination. Participants prepared for the experimental session by completing practice trials until they demonstrated understanding of the task.

After completing the practice portion, participants began the experimental session. Each participant named the black and white pictures depicting words within each condition: positive (i.e., high arousal, positive valence), negative (i.e., high arousal, negative valence), and neutral (i.e., low arousal, neutral valence; see Figure 1). Participants were randomly assigned into one of two presentation sequences. Order 1 consisted of conditions presented in the following order: neutral 1, positive, neutral 2, negative, and neutral 3. Order 2 consisted of the conditions presented in the following order: neutral 1, negative, neutral 2, positive, and neutral 3. Immediately following each condition, participants completed the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) followed by a 3-minute wait period. The SAM is a self-reported rating scale that was used to determine participants' perceived arousal and pleasure immediately following each condition. Participants received a SAM rating scale to determine valence with

faces depicting a range from happy to unhappy. Participants were instructed to select the image matching their immediate feelings by placing an "X" on a corresponding figure, with the far-left figure representing feeling "happy, pleased, or satisfied," and the far right representing feeling "unhappy, annoyed, or unsatisfied." The following SAM then assessed levels of arousal with a range of faces depicting a range from excited to calm. Participants were instructed to place an "X" on the far left if they are currently feeling "stimulated, excited, or aroused" and on the far right if they are feeling "relaxed, calm, or unaroused." After completing the SAM for both valence and arousal, participants had a 3-minute wait period before beginning the next condition.
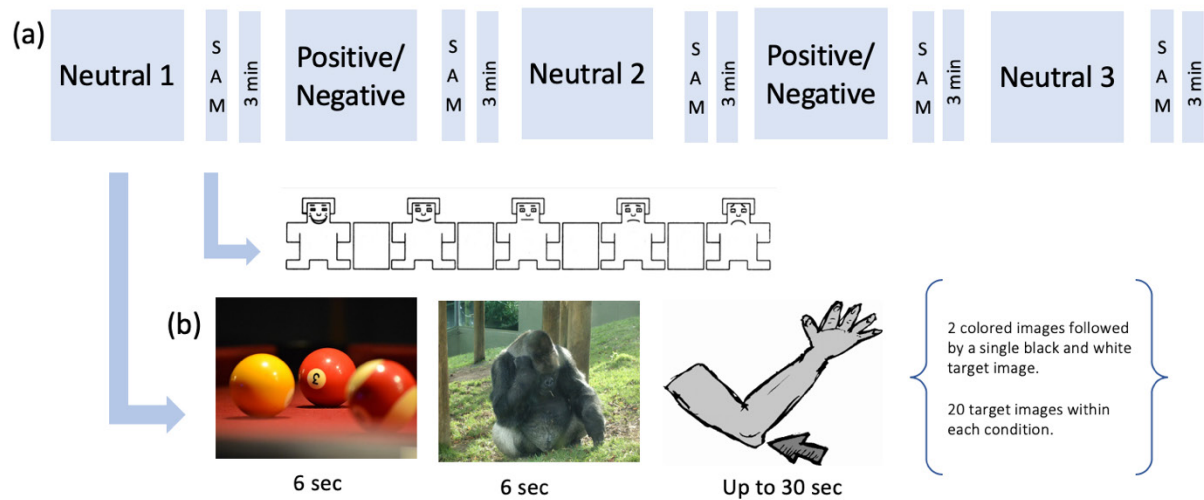


*Figure 1.* Study procedures with an example of the (a) presentation order for the three emotional stimuli and (b) stimuli and order procedure within the *neutral* condition.

## Measures

Any response matching the target word or predetermined acceptable alternative was considered correct, in addition to variations in plurality, tense, and the addition of modifiers. Acceptable alternatives were identified based on synonyms repeatedly produced during the pilot testing. Five items were excluded from analysis because the pilot group was unable to achieve

80% accuracy. One additional item was excluded for participant AE09 (i.e., nun) due to examiner error. For this study, accuracy was evaluated further using guidelines from the Philadelphia Naming Test (Dell, Schwartz, Martin, Saffran, & Gagnon, 1997). Responses in error were phonetically transcribed using audio-video recordings of the experimental session. Accuracy of each response was coded based on the participants' first complete attempt. A complete attempt is the first minimally consonant-vowel (CV) or vowel-consonant (VC) response (with the exception of schwa). The attempt cannot be self-interrupted (cut-off) and must have clear upward or downward intonation. Responses were coded according to the following error classifications: correct, description, formal (i.e., real word phonologically related), mixed, nonword phonologically related, nonword phonologically unrelated, semantic error, unrelated, miscellaneous, and no response. Responses scored as miscellaneous include picture part errors and morpheme omissions (including compounds). Examples of errors classified by error code are listed in Table 3.

Table 3

*Error Code Examples*

| Error Code | Target Word | Participant Response |
| --- | --- | --- |
| Description | Traffic | Stop |
| Formal Error | Tire | Tired |
| Mixed Error | Rat | Rabbit |
| Nonword Phon. Related | Ambulance | æmjulɛns |
| Nonword Phon. Unrelated | Tiger | ɛmprʌ |
| Semantic Error | Lung | Heartbeat |
| Unrelated | Whip | Arrow |
| Miscellaneous | Toe | Nails |

Coding errors was completed in a two-step iterative process. During the first iteration, the author coded all responses and an undergraduate research assistant independently coded all incorrect items. During the second iteration, more careful attention was given to the phonological similarity of each response compared to the target and each coder independently re-coded all responses in error. Discrepancies were identified with 20 items (9%) and were then discussed with a third coder until consensus was established.

**Research Design**

This study was conducted as an ABA case series design where each participant was exposed to all conditions (i.e., positive, negative, and neutral). The order was counterbalanced among participants based on pseudorandom assignments. An ABACA and ACABA format (where A = neutral, B = high arousal, positive, C = high arousal, negative) encouraged a return to baseline, with a 3-minute resting period between conditions to reduce carryover effects. This design allowed for examination of individual and group responses across conditions.

**Data Analysis**

Data were analyzed using a combination of repeated-measures ANOVA and visual inspection. A univariate repeated measures ANOVA was used to analyze group-level changes in perceived pleasure and arousal (i.e., SAMa and SAMp) and accuracy as a function of condition. Significant results were followed up with Tukey's HSD. Visual inspection is the gold standard for single subject design analysis (Kazdin, 2011). Visual inspection of the data allowed for investigation of experimental control through observation of changes in accuracy on both introduction and withdrawal of positive and negative conditions. Accuracy data were plotted for each individual participant to facilitate visual inspection. Statistical analyses were completed using R 3.4.1 (R Core Team, 2017). Analyses of variance were completed on models built using

the lme function within the nlme package (Pinheiro, Bates, Debroy, Sarkar, & R Core Team, 2017), and pairwise comparisons were made on the model using the emmeans package (Lenth, 2017). Data met assumptions of normality and homogeneity of variance.

**Results**

Descriptive statistics for all dependent variables (i.e., SAMa, SAMp, Accuracy) are included in Table 4. In general, average SAM ratings in the negative condition were higher for arousal and lower for pleasure. An overall decrease in naming accuracy during the negative condition was noted in descriptive statistics but was not determined to be statistically significant.

We hypothesized that perceived arousal and pleasure as reported by PWA would correspond to the differing conditions. Although descriptive statistics indicate that PWA generally reported increased arousal during the negative condition, no statistically significant difference across conditions was found ($F[4,32] = 1.313$, $p = .286$). The SAM pleasure ratings, however, did reveal a statistically significant difference across conditions ($F[4,32] = 6.511$, $p =$ <.001). Post-hoc analyses indicated statistically significant differences between the negative and neutral 1 condition ($p < .001$), the negative and neutral 2 condition ($p = .011$), the negative and neutral 3 condition ($p = .028$), and the negative and positive condition ($p = .007$). No other statistically significant differences in pleasure ratings were found.

We hypothesized that negative and positive emotion conditions would facilitate naming accuracy for people with aphasia. Contrary to this hypothesis, analysis of accuracy data show no significant condition effect ($F[4,32] = 2.115$, $p = .102$). No main effect was found, but descriptive statistics showed that accuracy in the negative condition was generally lower for PWA.

Table 4

*Descriptive Statistics*

| Condition | Statistics | SAMa | SAMp | Accuracy (%) |
|-----------|-----------|------|------|--------------|
| N1 | M | 5.00 | 7.56 | 75.44 |
| | SE | 1.00 | 0.60 | 6.14 |
| | Min | 1.00 | 5.00 | 42.11 |
| | Max | 9.00 | 9.00 | 100.00 |
| Neg | M | 6.22 | 4.67 | 63.71 |
| | SE | 0.68 | 0.73 | 5.69 |
| | Min | 3.00 | 1.00 | 38.89 |
| | Max | 9.00 | 8.00 | 88.89 |
| N2 | M | 5.22 | 6.78 | 73.68 |
| | SE | 0.76 | 0.43 | 5.69 |
| | Min | 1.00 | 5.00 | 47.37 |
| | Max | 8.00 | 9.00 | 94.74 |
| Pos | M | 5.11 | 6.89 | 67.09 |
| | SE | 0.77 | 0.56 | 5.85 |
| | Min | 1.00 | 4.00 | 42.11 |
| | Max | 8.00 | 9.00 | 94.74 |
| N3 | M | 5.00 | 6.56 | 68.33 |
| | SE | 0.75 | 0.47 | 6.87 |
| | Min | 1.00 | 5.00 | 35.00 |
| | Max | 9.00 | 9.00 | 95.00 |

**Individual Participant Responses**

People with aphasia demonstrated a trend toward decreased naming accuracy in the negative condition compared to neutral conditions. In addition, visual inspection was performed to analyze individual participant results. Visual inspection of individual participant accuracy performance across conditions revealed a decrease in accuracy in the negative condition followed by a return to baseline for 5/9 (56%) participants (i.e., AE01, AE03, AE05, AE06, and

AE09). Two participants (i.e., AE02 and AE04) showed a slight increase in performance (< 4%) in the negative condition; however, with no clear return to baseline in neutral conditions we cannot conclude that there was any condition effect. With no obvious condition effect for AE02 and AE04, the gradual but clear downward effect over time may be the result of fatigue. One participant (i.e., AE08) demonstrated a slight decrease in the negative condition; however, it was not judged to be meaningful as the effect was minimal. Decreased accuracy in the positive condition was observed for two participants (i.e., AE01 and AE03).

**Error Code Patterns**

An exploratory analysis of participants' individual error codes within each condition revealed general trends in error types. Participants who demonstrated an effect in the negative condition were observed to produce a larger proportion of semantically related errors, including mixed and description errors (i.e., errors related to the semantic-lexical level of processing), than any other error types. While several also produced semantically-related errors, participants without a condition effect generally produced a greater proportion of phonological, nonword (e.g., AE04), or "no response" errors (e.g., AE02 and AE10).

Five participants demonstrated an increase in descriptive errors in high arousal compared to neutral conditions. Two participants (i.e., AE03 and AE08) demonstrated this increase in both positive and negative conditions, while three (i.e., AE01, AE09, AE10) demonstrated this increase in the negative condition only. Similarly, three participants (i.e., AE03, AE08, AE10) presented with unrelated errors that were only present in high arousal conditions. Two participants (i.e., AE02 and AE06) demonstrated no differences in error type based on condition; however, 61% (23/38) of AE02 errors were coded as "no response" and AE06 had a total of only five errors across all conditions.

**Discussion**

The purpose of this preliminary study was to investigate the effects of emotional arousal and valence on naming accuracy on a confrontational naming task for PWA. Participants with aphasia were asked to name black and white images presented on a computer screen, as quickly and accurately as possible. Following each condition, participants reported their perceived arousal and pleasure. Although participants with aphasia did not report greater perceived arousal in the positive or negative conditions, they did report a decrease in perceived pleasure following the negative condition. Naming accuracy generally decreased in the negative condition, which was substantiated by a clear decrease followed by return to baseline for over half of the participants. There was no difference in naming accuracy in the positive condition compared to neutral.

Much of the previous literature surrounding the effects of emotion on language tasks in PWA has found that emotional content facilitates language across a number of receptive and expressive language tasks (Berrin-Wasserman et al., 2003; Bloom et al., 1993; Landis et al., 1982; Lorch et al., 1998; Ramsberger, 1996; Reuterskiold, 1991). In contrast, the present study suggests that negative valence during a confrontational naming task may interfere with linguistic processing as evidenced by decreased accuracy. These findings best align with DT, suggesting that strong emotions can interfere with cognitive processing by diverting attentional resources to emotional regulation (Blackett et al., 2017; DeCaro et al., 2011).

Although the results of the present study differ from what we hypothesized based on previous reports, several explanations could account for these unanticipated findings. First, the task being investigated is novel. Previous research has investigated the effects of emotion on various language tasks in aphasia (e.g., repetition and word discrimination) but none have looked

at confrontational naming specifically. Confrontational naming requires increased linguistic processing compared to other language tasks (e.g., repetition tasks). Ramsberger (1996) found that PWA demonstrated improved repetition for stimuli with emotional value compared to non-emotion words. While this study and the present study both involved expressive language tasks, the confrontational naming task performed by PWA in the present study required participants to engage in all parts of the word retrieval process from conceptualization to production, including semantic-lexical retrieval. Many participants who showed a negative condition effect produced errors consistent with impaired semantic-lexical activation (i.e., AE01, AE03, AE05, and AE09). This phase of the word retrieval process, however, would not have been required during the previously studied repetition task. The interference effect on naming that we saw during the negative condition, therefore, may only be seen in tasks that require semantic-lexical retrieval.

Second, the emotional state of the participants might have impacted their language performance. Previous research that used a similar approach to investigate language tasks in PWA evaluated the effects of emotion based solely on whether the stimuli were emotionally laden (Landis et al., 1982; Ramsberger, 1996; Reuterskiold, 1991). This study differed in that we were not only interested in the emotionality of the stimuli but also the emotional state of the participant. For this reason, pictures were used to reinforce the intended emotional state. These reinforcement images may be meaningful in that emotional stimuli alone may have resulted in different effects. With the emotional reinforcements in place, participants may have had to regulate their emotional response in addition to naming the target item (Blackett et al., 2017; Cahana-Amitay et al., 2011). Blackett et al. (2017) researched the effect of valence during a confrontational naming task in neurotypical adults and found that response times were significantly longer for high arousal images (i.e., positive and negative conditions) compared to

neutral images. The authors attributed the decrease in performance to a disengagement of attentional resources from the emotional images prior to completion of the naming task. Similarly, emotionally arousing stimuli might interfere with lexical retrieval in some PWA by creating a high-anxiety situation resulting in decreased language performance (Cahana-Amitay et al., 2011).

Third, control of different linguistic variables related to stimulus sets may have impacted performance on the language tasks. Previous research that investigated the effects of emotion on language tasks demonstrated an inability to control for many linguistic variables as a consistent limitation (Blackett et al., 2017; Ramsberger, 1996). Ramsberger (1996) controlled for concreteness and frequency of occurrence when developing stimuli for a repetition task for PWA; however, she neglected to account for other linguistic factors that are thought to influence the way words are processed (i.e., familiarity, imageability, and articulatory complexity) (Coltheart, 1981). Similarly, Blackett et al. (2017) selected target images for a confrontational naming task in neurotypical adults that were controlled for concreteness, number of syllables, and word frequency but failed to control for articulatory complexity and imageability. It is possible that the increase in response time observed in high arousal conditions could be the result of differences in articulatory complexity between stimuli or variations in visual complexity of images, with more visually complex images resulting in increased processing time. The present study controlled for a larger number of language variables than have been controlled for in previous research in order to account for these possible effects.

Fourth, aphasia severity may influence how emotion affects language production. Past studies looking at language tasks in PWA included people who had severe deficits in the task being tested. For example, Ramsberger (1996) included only participants with severe repetition

deficits (i.e., < 50th percentile on repetition subtest). Similarly, Reuterskiold (1991) included only participants with a score below the 60th percentile on the word discrimination subtest of the Boston Diagnostic Aphasia Examination (BDAE, Goodglass et al., 1983). Unlike these two studies, however, the present study included participants who demonstrated the presence of word-finding deficits on the BNT-short form, with severity levels ranging from mild (e.g., AE05) to severe (e.g., AE02). Although severity did not seem to have an effect on consistent patterns, participants with a relatively mild naming deficit (i.e., AE01, AE05, and AE09) demonstrated a clear negative condition effect, whereas those with more severe naming deficits (i.e., AE02, AE03, AE08, and AE10) were more variable. This might be the result of participants with mild aphasia having more attentional resources to process their emotional reactions while simultaneously completing a language task. Based on the SAM arousal ratings, most participants with mild aphasia did report higher arousal following the negative condition; however, participants with more severe aphasia, in general, reported lower arousal than those with mild aphasia after the negative condition. Participants with more mild aphasia might have had a stronger emotional reaction to the negative condition and subsequently become distracted as they attempted to perform the task while regulating their emotional response. It is possible that these high arousal emotional responses actually interfere with linguistic performance by acting as a distractor.

**Limitations**

Limitations of this preliminary study include a small sample size (n = 9), lack of a control group, and inclusion of participants who presented with a broad range of aphasia severities. Previous studies investigating language tasks in PWA have also used relatively small (8 < n < 16) sample sizes (Boller et al., 1979; Khatoonabadi et al., 2015; Reuterskiold, 1991). However,

small sample sizes are not robust to statistical analysis. For this reason, the present study involved analysis of both group and individual performance. Future research should include more participants and consider adding a control group for comparison. Studies may consider a similar design but focus on participants with only mild-moderate task-specific deficits (e.g., word-finding difficulties) or consider separating participants into groups based on severity of aphasia (e.g., mild-moderate and moderate-severe) to determine the effect of aphasia severity on confrontational naming.

Additionally, the aphasia group did not report higher emotional arousal in the negative or positive conditions. It is possible that participants did not perceive greater arousal in those conditions. Future studies may attempt to elicit an emotional response within participants outside of the stimuli themselves. An emotional response may be provoked from exposure to music, visual imagery, or participation in an autobiographical recall task. It is also possible that participants did not understand the instructions of this rating task, which were given verbally. Future research should attempt to correct for this by creating a rating task that minimizes necessary linguistic processing. Integration of physiological measurements (i.e., heart rate variability and perspiration) in future experimental design may improve understanding of individual emotional responses to various conditions.

**Clinical and Research Implications**

Researchers have investigated the effects of social stressors on language tasks in PWA and found that stress might interfere with language performance (Cahana-Amitay et al., 2015; Harmon, Jacks, Haley, & Bailliard, 2020). Performing a language task in itself can be anxiety inducing, interfering with individual task performance (Cahana-Amitay et al., 2011). This knowledge should inform clinical practice in regard to assessment and treatment as we recognize

that one's emotional state might negatively impact behavioral performance. Evaluating mood and emotion as part of assessment can ensure that PWA are in a condition to respond most effectively to treatment. Additionally, it is important to maintain consistency in research or outcome measurements across mood states. For this reason, we suggest that clinicians and researchers might consider screening their client's or participant's mood (e.g., DVAMS) to ensure consistency between pre and posttreatment testing.

**Conclusion**

The purpose of this preliminary study was to investigate the effects of emotional valence and arousal on a confrontational naming task for PWA. In contrast with previous findings suggesting a facilitative effect of emotionality on language tasks in PWA, combined quantitative and qualitative findings showed that high arousal emotional stimuli had an inhibitory effect on naming accuracy in the negative condition during a confrontational naming task. We propose that participants with more mild aphasia experience an emotional reaction to the negative condition, detracting their attention from the naming task in order to regulate their emotional response. This emotional response interferes with linguistic performance resulting in decreased naming accuracy in the high arousal negative condition. When appropriate, clinicians should account for mood effects in both assessment and treatment of PWA. Future research should investigate the effects of emotionality on confrontational naming among a larger sample while controlling for aphasia severity.

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APPENDIX A

**Annotated Bibliography**

Bauerly, K. R., & Paxton, J. (2017). Effects of emotion on the acoustic parameters in adults who

stutter: An exploratory study. *Journal of Fluency Disorders*, *54*, 35–49.

https://doi.org/10.1016/j.jfludis.2017.09.006

*Objective:* This study aimed to further analyze the effect of emotion on the speech-motor control abilities in people who stutter by observing acoustic parameters in the fluent speech of people who stutter compared to a control group when speaking under emotionally arousing conditions. *Method:* Participants included 10 males who stuttered and 10 males who did not stutter. Participants completed three tasks during the study: (1) viewed images on a computer screen, (2) read words presented on a computer screen, and (3) rated their feelings in relation to picture viewing.  The images were of three different emotional states: neutral, increased arousal/pleasant, and increased arousal/unpleasant. These images were selected from the International Affective Picture System (IAPS), set of over 1000 emotionally evocative, internationally-acceptable, color photographs that include normative ratings of pleasure and arousal. *Results/Conclusion:* Adults who stuttered demonstrated differences in articulatory movement when arousal was heightened compared to neutral. The valence (whether positive or negative) did not prove significant. People with stuttering greater changes in articulatory movement compared to the control group of males who do not stutter. An increase in the speed of movements was noted in both groups, but the increased speed likely placed more demands on AWS leaving them vulnerable to breakdowns. *Relevance:* The International Affective Picture System utilized in this study will likely influence the development of picture stimulus used in our

study to evoke a desired emotional response during the naming task. The method of emotion priming will also be considered as we attempt to prime participants with content matching the stimulus valence in order to strengthen naming accuracy. This study suggests that high arousal stimuli leads to increased gains in muscle movement, affecting reaction to stimuli.

Berrin-Wasserman, S., Winnick, W. A., & Borod, J. C. (2003). Effects of stimulus emotionality and sentence generation on memory for words in adults with unilateral brain damage. *Neuropsychology*, *17*, 429–438. https://doi.org/10.1037/0894-4105.17.3.429

*Objective:* This study set out to determine if emotionality enhanced verbal memory performance in individuals with neurological impairment in general. Individuals who had a stroke were chosen as their cerebrovascular lesions are typically contained to one hemisphere. They hypothesized that emotionality would aid memory performance for both the healthy control group and the participants who had left hemisphere (LH) damage. *Method:* Target stimuli consisted of 96 emotional and non-emotional words combined. Ratings determined the intensity and valence of emotionality on a 7-point scale. Imaginability and familiarity were also considered in choosing words. Participants with right hemisphere (RH) brain damage, left hemisphere (LH) brain damage, and healthy adults completed the study. The experiment consisted of two processing conditions and two retrieval tasks with both emotional and non-emotional words. *Results/Conclusion:* Results did not support previous findings as data analysis revealed that emotional content had the same effect on all participants, with improvements on emotion content regardless of valence. Generative tasks had a facilitative affect compared to reading tasks. *Relevance:* The methods used to obtain a list of emotional and non-emotional words in this study may influence our process of determining stimulus materials. The rating scale

used helped to classify the words based on valence, intensity, imaginability, and familiarity. In addition, results of this study suggest that emotionality has a facilitative for memory deficits in both RH and LH damage while our hypothesis likely suggests that emotionality will affect the right and left hemispheres differently.

Blackett, D. S., Harnish, S. M., Lundine, J. P., Zezinka, A., & Healy, E. W. (2017). The effect of stimulus valence on lexical retrieval in younger and older adults. *Journal of Speech, Language, and Hearing Research*, *60*, 1–9. https://doi.org/10.1044/2017_JSLHR-L-16-0268

*Objective:* This study set out to investigate whether the emotional valence of stimuli impacts lexical retrieval in healthy younger and older adults during a picture naming task. *Method:* 18 healthy younger adults and 18 older adults participated in the study. Stimulus pictures were selected from the International Affective Picture System (IAPS) based on features of concreteness, valence, and emotional arousal. Participants viewed a total of 60 images on a laptop. Pictures were presented in 20-picture blocks according to valence in order to limit carryover. Between blocks the participants would complete a distractor task to avoid carryover of emotional valence between blocks and to limit potential of task fatigue. *Results/Conclusion:* This study concludes that emotional arousal, but not necessarily valence, impacts naming latency in both younger and older adults. This could be due to a disengagement of attentional resources from the emotional mages prior to completion of the naming task. Data from the current study suggest that emotional arousal in a picture naming task leads to inhibition of, or interference with, lexical retrieval. *Relevance***:** Our study will use similar methods to compile stimulus pictures. It was noted that visual complexity was a variable that was not accounted for. An

increase in processing time could be related to the time it took to view and process various images. Similarly, our study will consider a similar set up where a distractor task is inserted to disrupt possible carryover effects. While this study considered the target word, a synonym, and variety in plurality from the target word as accurate, our study will likely need to incorporate a point range to apply partial points when semantic paraphasia and verbal paraphasia arise, a likely error in naming for people with aphasia.

Bloom, R. L., Borod, J. C., Obler, L. K., & Gerstman, L. J. (1993). Suppression and facilitation of pragmatic performance: Effects of emotional content on discourse following right and left brain damage. *Journal of Speech and Hearing Research*, *36*, 1227–1235.

*Objective:* This study aimed at examining the effect of emotional content on the verbal pragmatic aspects of discourse production in individuals with left- or right- brain-damage compared to a normal control group. *Method:* Participants were asked to remember emotional and non-emotional experiences and were instructed to give a monologue that was transcribed and rated. The monologues were rated for appropriateness on conciseness, lexical selection, quantity, relevancy, specificity, and topic maintenance. *Results/Conclusion:* Results showed that individuals who had brain damage were rated as significantly less appropriate than the normal control group. Emotional content proved to have a facilitative effect for individuals who had suffered left hemisphere damage and suppressed performance of participants with right hemisphere brain damage. These results are consistent with the facilitative effect hypothesis of emotionality. Individuals with right brain damage had increased impairment with positive emotions while individuals with left brain damage had increased impairment with negative emotions. *Relevance:* While our study will be analyzing picture naming rather than discourse,

the results further support the need for continued study on the effects of emotional content on individuals with left hemisphere brain damage specifically. Our study may also note the conditions on which stimuli in this study were created with emotional, visuospatial and procedural aspects considered.

Boller, F., Cole, M., Vrtunski, P. B., Patterson, M., & Kim, Y. (1979). Paralinguistic aspects of auditory comprehension in aphasia. *Brain and Language*, *7*, 164–174. https://doi.org/10.1016/0093-934X(79)90014-2

*Objective:* The aim of this study is to evaluate the role of emotional content and mode of presentation (i.e., live voice or audio recording) of a series of sentences on the comprehension of severe aphasics. *Method:* 8 individuals, ranging in age from 38 to 77, with diagnosed aphasia due to unilateral vascular lesions on the left hemisphere participated in the study. Each patient received the series of 60 stimulus sentences, including 10 with high emotional content, 20 with low emotional content, and 30 intended to be neutral, by one of the two modes of presentation. For the "voice" presentation, the examiner read the sentences while sitting in front of the participant. The examiner avoided gestures, facial expressions, and emotional vocal intonation. The "tape" mode produced the same sentences previously recorded by the same examiner. The participants experienced the two modes during separate sessions. *Results/Conclusion:* Participants were more likely to produce a response when the sentences were spoken directly by the examiner compared to an audio recording. The results of the study conclude that both the content of a sentence and mode of presentation style significantly influence the response to an auditory stimulus. It is possible that emotional content actually facilitates an individual with aphasia's phonemic and semantic decoding abilities. *Relevance:* Stimuli were created by the

authors and then five people with aphasia independently classified the sentences as "emotional" or "neutral." Our study will likely draw from previous word and picture list with established valence and will be evaluated to determine emotionality, likely using a larger sample than five.

Boyle, M. (2010). Semantic feature analysis treatment for aphasic word retrieval impairments: what's in a name? *Topics in Stroke Rehabilitation*, *17*, 411–422. https://doi.org/10.1310/tsr1706-411

*Objective:* The article set out to discuss various studies that have used various treatment paradigms all referred to as semantic feature analysis (SFA). A specific focus will be placed on the effects of improved naming and maintenance on treated items, and generalization of improvements on untreated items. *Method:* Seven published studies were reviewed for having applied SFA to individuals with aphasia at the confrontation naming level for nouns. Studies varied in methods and were labeled as semantic feature generation (SFG) when the participants were required to generate the semantic features and were labeled semantic feature review (SFR) when participants with aphasia had to recognize and respond to semantic features that were generated by investigators. *Results/Conclusion:* Each paradigm independently called semantic feature analysis treatment, including SFG, SFG+SFR, and SFR, resulted in improved noun naming in individuals with various types of mild to moderate aphasia. Individuals who received SFR treatment were least likely to maintain treatment effects after treatment ended. Generalization was most notable in treatment using the SFG+SFR paradigm. *Relevance:* This literature review provides information about improving naming accuracy in individuals with aphasia. Our study will specifically consider how emotion plays a role in naming accuracy during confrontational naming tasks and may draw from methods used in these studies reviewed.

Brysbaert, M., Warriner, A. B., & Kuperman, V. (2014). Concreteness ratings for 40 thousand
    generally known English word lemmas. *Behavior Research Methods*, *46*, 904–911.
    https://doi.org/10.3758/s13428-013-0403-5

*Objective:* The aim of this study was to run an updated concreteness rating study on a large

sample of English words to create a word list to be drawn from for future research. *Method:*

60,099 words and 2,940 two-word expressions were distributed over 210 lists of 300 words, and

10 calibrator words and 29 control words were added. Participants were instructed to rate words

on a scale of 1 to 5, from abstract to concrete. In depth explanation was provided.

*Results/Conclusion:* A comprehensive wordlist including nearly 40,000 English lemmas, with

concreteness ratings was the result of the study. Notably, ratings established supported existing

norms. *Relevance:* The word list that was produced as a product of this research will be drawn

from as we compile a list of words and consider concreteness ratings.

Chen, Q., Middleton, E., & Mirman, D. (2018). Words fail: Lesion-symptom mapping of errors
    of omission in post-stroke aphasia. *Journal of Neuropsychology*, *2(13)*, 183-197.
    https://doi.org/10.1111/jnp.12148

*Objective:* Errors of omission involve a failure to attempt to name the object presented. The aim

of the study was to investigate the relationship between lesion location and omission errors in a

picture naming task. *Method:* 123 individuals with aphasia as the result of a unilateral left

hemisphere stroke were administered the Philadelphia Naming Test (PNT), comprised of 175

black and white line drawings of familiar objects from various semantic categories. The results

were analyzed using support vector regression lesion-symptom mapping. *Results/Conclusion***:**

The study found that omission errors were most strongly associated with left frontal and mid-

anterior temporal lobe lesions. Results suggest that omission errors are associated with impaired semantically driven lexical retrieval and not phonological retrieval. *Relevance:* Our study will likely draw from the classifications described in this study to differentiate between naming error types. Additionally, the Philadelphia Naming Test (PNT) will influence our considerations in picture naming stimuli.

Coelho, C. A., Mchugh, R. E., & Boyle, M. (2000). Semantic feature analysis as a treatment for aphasic dysnomia: A replication. *Aphasiology*, *14*, 133–142. Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed5&NEWS=N&AN=2000095884

*Objective:* This case study set out to replicate a previous study done by Boyle and Coelho (1995) studying Semantic Feature Analysis (SFA) on confrontation naming tasks and generalization to connected speech. This study involved an individual with moderate fluent aphasia secondary to a closed head injury. *Method:* A 52-year-old male with moderate to severe fluent aphasia was the participant in the case study. Stimuli included black and white line drawings standardized by Snodgreass and Vanderwart. Three 60-minute treatment sessions were conducted each week. SFA involved placing a picture in the center of the feature analysis chart. The participant was guided to verbalize the semantic features of the target word, even if he was able to offer the target word itself. Generalization to connected speech was analyzed through various speech samples. *Results/Conclusion:* The study concluded that SFA resulted in gains in confrontation naming of both trained and untrained stimulus pictures. The gains also generalized to connected speech, differing from the original study in 1995. *Relevance:* Our study may consider the stimuli

used and factors accounted for including name agreement, image agreement, familiarity, and visual complexity

Conroy, P., Drosopoulou, C. S., Humphreys, G. F., Halai, A. D., & Lambon Ralph, M. A. (2018). Time for a quick word? The striking benefits of training speed and accuracy of word retrieval in post-stroke aphasia. *Brain*, *141*, 1815–1827. https://doi.org/10.1093/brain/awy087

*Objective:* This study set out to determine the efficacy of a novel treatment for aphasia aimed at reducing speech and increasing picture naming accuracy simultaneously in the hopes that results will generalize to improvements in connected speech. The treatment being studied is called repeated, increasingly-speeded production (RISP). *Method:* Twenty participants with aphasia took part in 12 computer-based treatment sessions over 6 weeks. Participants received either speed- and accuracy-focused treatment, standard accuracy-only treatment, or were left untreated (control). Participant's performance was scored based on their first response when presented with a picture. Baseline, treatment, and follow-up assessment was analyzed. *Results/Conclusion:* The study concluded that both treatments increased picture naming accuracy and was maintained 1-month after treatment without maintenance practice. As hypothesized, RISP generated significant improvements in targeted items in connected speech. *Relevance:* Our study will draw from the methods used to determine accuracy of responses in confrontational naming tasks. This study allowed participants 10 seconds to respond to the picture stimuli. When the picture was presented, a tone sounded and began the 10 seconds. The first response was used although self-corrections were considered correct if the correct name was produced immediately after the first response.

Conroy, P., Sage, K., & Lambon Ralph, M. A. (2009). The effects of decreasing and increasing

cue therapy on improving naming speed and accuracy for verbs and nouns in aphasia.

*Aphasiology*, *23*, 707–730. https://doi.org/10.1080/02687030802165574

*Objective:* This study intended to determine the effects of decreasing cue therapy compared to increasing cue therapy on both naming accuracy and speed. *Method:* Seven participants with aphasia involving difficulty with word finding participated int eh case-series study. After assessment, participants received 10 sessions, 2 sessions per week for 5 weeks. Therapy involved either decreasing cue therapy or increasing cue therapy for noun and verb targets. Post-therapy naming was assessed 1-week and 5-weeks after therapy to provide immediate results and follow-up results respectively. Results were analyzed in a three-way ANOVA. *Results/Conclusion:* The results indicate that decreasing cues are as affective in naming therapy as increasing cues for accuracy and speech of naming verbs and nouns. *Relevance:* Our study will draw from methods used in this study to differentiate between types of naming errors. Researches in this study categorized errors as semantic, phonological, unrelated, or no response. Additionally, the Boston Naming Test was used to determine eligibility for the study. Our use of the naming portion of the Western Aphasia Battery (WAB) will address the same purpose of capturing participants with naming difficulty but exclude severe global aphasia that results in inability to name test items.

Czimskey, N., & Marquardt, T. P. (2018). Recall of emotional and neutral words and paragraphs

in traumatic brain injury. *Aphasiology*, *00*, 1–16.

https://doi.org/10.1080/02687038.2018.1512079

*Objective:* The study aimed to determine the effects of emotional stimulus on verbal recall of words and paragraphs in individuals who have had a traumatic brain injury (TBI) compared to

non-brain injured (NBI) individuals. *Method:* Twenty individuals with TBI and 44 NBI individuals participated in the study. Participants listened to six lists of stimuli, each with five emotional and five neutral words. Additionally, they listened to six paragraphs, three emotional and three neutral. Participants were then instructed to recall the words from the stimuli list and retell the paragraph. *Results/Conclusion:* The healthy control group had greater recall for emotional stimuli in both word lists and paragraphs compared to neutral words. Similarly, emotional word recall was also greater for individuals with TBI. They did not, however, see the same benefits at the paragraph level. *Relevance:* This study offers a foundation for the influence of emotion in word recall, including its facilitative affect, supporting our research aim.

Hamberger, M. J., & Seidel, W. T. (2003, March). Auditory and visual naming tests: Normative and patient data for accuracy, response time, and tip-of-the-tongue. *Journal of the International Neuropsychological Society*, *9*, 479-489. https://doi.org/10.1017/S135561770393013X

*Objective:* Word retrieval is often assessed visually through the use of line drawings, although acoustic means are thought to be more functional. The aim of this study was to develop comparable auditory and visual naming tasks that can be used clinically for assessing word retrieval. *Method:* Responses from the 56 patients with unilateral left temporal lobe epilepsy (TLE) and a sample of normal healthy adults were compared for acoustic and visual stimuli tasks. *Results/Conclusion:* Results showed that all participants demonstrated increased difficulty on auditory naming compared to visual naming tasks. However, visual naming performance did not correlate with subjective complaints of word finding difficulty when auditory naming performance did. *Relevance:* This article offered unique insight on accuracy and scoring as they

measured "tip-of-the-tongue" experiences defining them as correct response given after a phonemic cue was offered or a correct response 2+ seconds after the 20 seconds of stimulus presentation.

Hielscher, M. (2004). Comprehension of emotional information in patients with aphasia. *Folia Phoniatrica et Logopaedica*, *56*, 14–26. https://doi.org/10.1159/000075325

*Objective:* Past studies have produced somewhat inconsistent data regarding the right hemisphere's involvement in emotion processing, resulting in several hypothesis (e.g., quantitative hypothesis, qualitative hypothesis, etc.). This study further analyzes the comprehension of emotional information specifically aimed at determining the influence of the left hemisphere on interpretation of emotional information, for both verbal and nonverbal tasks. *Method:* 74 right handed monolingual subjects participated in the two experiments. The groups consisted of healthy controls and individuals with left hemisphere lesions (LHL) or right hemisphere lesions (RHL). Both males and females participated in the study. Patients showed either no or mild aphasic symptoms and were all able to read fluently with semantic understanding. Texts were developed to follow the emotion-antecedent appraisal approach to facilitate priming of emotions. By doing so, texts could be described by their valence (positive vs. negative) and norm orientation. During the first experiment, participants read six texts, two with the specific coherent emotion (CE), two with an emotion lacking the correct attribution information (WA), and two texts with an emotion of opposite valence (WV). During the second experiment, lexical decisions were interspersed. The experiments tested the effects of explicit emotion priming, lexical association, and mental foregrounding and focus on text comprehension. *Results/Conclusion***:** Insignificant differences were found with emotional

inferencing in LHL and RHL patients compared to healthy controls. Emotion priming did not prove to have a facilitative affect as priming with emotion-typical compared to an emotion word of opposite valence produced similar responses. Results support neither the quantitative nor the qualitative hypotheses since there was no significant different between patient groups, including stimuli with negative valence. *Relevance:* Our study intends to implement the use of priming for valence prior to the test picture. This study also acknowledges variables to account for and possible participant mood affects that will influence our study.

Khatoonabadi, S. R., Dadgar, H., Bakhtiari, B., Khosravizadeh, P., Shaygannejad, V., & Bakhtiyari, J. (2015). Comparison of emotional and non-emotional word repetitions in patients with aphasia. *Advanced Biomedical Research*, *4*, 164. https://doi.org/10.4103/2277-9175.162540

*Objective:* This study aimed at investigating the effect of emotion during a word repetition task in the Persian language for individuals who had a stroke resulting in aphasia. *Method:* While other studies have used methods of picture description, storytelling, and direct question or conversation for the elicitation of language expression, this study argues that the best method for speech output research is through word repetition tasks. 15 people with aphasia participated in the cross-sectional study. The first task was to develop an appropriate stimulus list capturing emotionality and valence. The emotional and non-emotional words were developed as 30 neurotypically normal Persian speakers rated words on a scale of 1-7, with one being low emotionality and seven being high emotionality. This process resulted in a list of 20 emotional and 20 neutral stimulus words for the study. They were then divided into positive and negative words. Each qualified participant was presented with stimuli verbally and asked to repeat the

word after five seconds. They were given a score of one when the target word was repeated correctly. A score of zero was given when the target word was not repeated correctly, including semantic paraphasia, neologism, and verbal paraphasia. *Results/Conclusion:* No significant difference was determined between emotion and neutral word repetition in persons with aphasia. These results differ from the Landis study that shows that emotional words process significantly faster than neutral words in oral reading and writing tasks. The study suggests that this difference could be due to the fact that word repetition deals with the output of language whereas the Landis study included visual aspects that deal with the input of language. It is also possible that there may be a cultural difference in processing emotional language that may not be isolated to the right hemisphere. *Relevance:* During data collection this study determined repetition accuracy as simply correct or incorrect. For our naming accuracy study, we will likely develop a range of values to capture potential errors and award partial points for some types of errors (e.g., semantic paraphasia and verbal paraphasia). Our study may draw on a similar process for developing picture stimulus as was used to categorize the emotionality and valence of stimulus words in this study.

Kousta, S. T., Vinson, D. P., & Vigliocco, G. (2009). Emotion words, regardless of polarity, have a processing advantage over neutral words. *Cognition*, *112*, 473–481. https://doi.org/10.1016/j.cognition.2009.06.007

*Objective:* This study set out to further the research regarding the effects of emotionality of cognition, with specific interest in determining whether polarity of valence affects processing. *Method:* ANEW valence and arousal words were used to compile 40 negative, 40 positive, and 40 neutral words. The same ratio of non-words was also created. Each participant viewed a cross

on the middle of a screen followed by a string of letters to which they were to respond by pressing a marked key if it was a word or nonword. Data was analyzed from 79 of the 108 undergraduate student participants. *Results/Conclusion:* Results support that positive and negative words are processed faster than neutral words resulting in faster latencies and greater accuracy. *Relevance:* This study suggests that for neurotypical individuals, arousal, regardless of valence, has a facilitative effect on neural processing.

Landis, T. (2006). Emotional words: What's so different from just words? *Cortex*, *42*, 823–830. https://doi.org/10.1016/S0010-9452(08)70424-6

*Objective:* The study aimed to determine whether emotional factors facilitate language. Specifically, the study asked if emotional loading was a factor in the production of words during controlled reading and writing conditions. In these conditions, the question was whether there was evidence that the right hemisphere of the brain is responsible for mediation of this process. *Method:* The population sample consisted of thirty-two males who met the inclusion criteria for participation, having both aphasic impairments (including both fluent and non-fluent classification types of varying degrees of severity) and radiological evidence of a unilateral cerebral brain lesion. The first test required participants read aloud 36 stimulus words that were presented in a random order. The 36 stimulus words included "abstract" emotional, concrete, and "abstract" non-emotional words. The second test required that the participants now write the stimulus word after it has been dictated. Participants' responses were scored as either "correct", "semantic substitution", or "incorrect". *Results/Conclusion:* Success was positively influenced by the emotionality, imageability, and the frequency of the target words. During both the reading and writing tasks, more semantic substitutions were present with emotion words than with non-

emotion words. Results indicate that performance of the patients with aphasia on these language tasks were affected in part by the right hemisphere. *Relevance:* The methods used to determine response naming accuracy will apply to our study as errors are categorized and classified as correct, incorrect, or another possible variation from the target. The concrete word list from this study will also guide the picture list we develop for testing.

Lifshitz Ben Basat, A., Gvion, A., Vatine, J. J., & Mashal, N. (2016). Transcranial direct current stimulation to improve naming abilities of persons with chronic aphasia: A preliminary study using individualized based protocol. *Journal of Neurolinguistics*, *38*, 1–13. https://doi.org/10.1016/j.jneuroling.2015.09.004

*Objective:* Transcranial direct current stimulation (tDCS) is a noninvasive tool that facilitates blain plasticity and enhances language recovery after a stroke. The study aimed to develop an appropriate protocol for individualizing tDCS to treat naming deficits in individuals with aphasia. *Method:* The study involved seven participants with chronic aphasia who all performed a baseline naming assessment. They were then involved in pre-intervention sessions to determine the location and type of stimulation that produced the greatest results. This was used during the remaining treatment sessions. Treatment involved six stimulation sessions, three treatments per week, two weeks in a row. Naming abilities were assessed immediately after treatment and one- and three-months post treatment. *Results/Conclusion:* An individualized treatment protocol involving six sessions of tDCS at an intensity of 2 mA for 10 minutes resulted in significant improvements in percentage of correct responses compared to baseline and remained present three months after treatment suggesting that tDCS will improve naming abilities in individuals with chronic aphasia. *Relevance:* Our study will also involve a naming task. We will note

variables accounted for in this study (e.g., frequency of use, concreteness, and number of letters) as we develop a stimuli word list for our naming task. Additionally, we too will consider the classifications of naming errors beyond a simple "accurate" or "inaccurate" classification.

Lorch, M. P., Borod, J. C., & Koff, E. (1998). The role of emotion in the linguistics and pragmatic aspects of aphasic performance. *Journal of Neurolinguistics*, *11*, 103–118. https://doi.org/10.1016/S0911-6044(98)00008-6

*Objective:* The aim was to offer a literature review considering linguistic and extralinguistic aspects of communication in individual's with left hemisphere brain-damage (LBD), right hemisphere brain-damage (LBD) compared to non-neurologically impaired normal controls (NC). The review focuses on intact abilities of emotional expression in LBDs and compares their performance to NCs. *Method:* Experiment 1 involved 15 males with LBDs, 12 males with RBDs, and 16 male NCs. Subjects viewed a slide designed to elicit expressions of positive or negative emotions during which spontaneous production of emotion was assessed. Two judges scored each response by rating for responsivity, appropriateness, and intensity of response while watching a videotaped recording. Experiment 2 involved 3 LBDs, 3 RBDs and 3 NCs from the 43 participants in experiment 1. Their spontaneous production responses were analyzed for intensity. Experiment 3 involved 12 LBDs, 9 RBDs, and 12 NCs who participated in a narrative from pictures. They were then judged by raters as "appropriate" or "inappropriate" on 7 pragmatic features including topic maintenance, conciseness, specificity, lexical selection, revision and repair, relevancy and quantity of information. *Results/Conclusion:* Reviewed research suggests that people with aphasia have the ability to successfully utilize emotion in the comprehension and expression of both linguistic and pragmatic content and contexts. Emotion

may play a faciliatory role in the comprehension and production of communication in language-impaired individuals. *Relevance:* The aim of our study intends to further investigate the relationship of emotionality with a specific interest in naming accuracy. Our research may consider similar images in order to evoke an intended emotional response.

Ramsberger, G. (1996). Repetition of emotional and nonemotional words in aphasia. *Journal of Medical Speech-Language Pathology*, *4*, 1–12. https://doi.org/10.1207/s15327752jpa8502

*Objective:* The purpose of this study was to investigate the effects of emotion (i.e., affect) influence single word repetition tasks in people with aphasia. They hypothesized that highly emotional words would facilitate repetition at the word level and that repetition of negative emotional words would be significantly greater than positive emotional words. This hypothesis drew from research stating that negative emotions are processed in the right hemisphere and positive emotions are processed in the left hemisphere, the area of damage for individuals with aphasia. *Method:* Participants included twenty male subjects with aphasia, and notable repetition difficulties, as evidenced by scores below the 50th percentile in repetition subtests of BDAE or PICA. A word list was developed through careful consideration of emotionality, concreteness, and frequency. A video recording of the stimuli was presented in groups of eleven words and the first response of the subject was scored by two speech-language pathologist judges as either recognizable or unrecognizable. *Results/Conclusion:* The results concluded that emotion words were repeated more frequently than nonemotion words. There was not, however, a significant difference between the repetition of negative and positive words. *Relevance:* This study reaffirms the need to account for concreteness of stimulus items as abstract words are more

difficult for individuals with aphasia to repeat. It also supports the need for further research on various processing components of speech. Repetition involved auditory processing and comprehension, likely affecting the data.

Raymer, A. M., McHose, B., Smith, K. G., Iman, L., Ambrose, A., & Casselton, C. (2012). Contrasting effects of errorless naming treatment and gestural facilitation for word retrieval in aphasia. *Neuropsychological Rehabilitation*, *22*, 235–266. https://doi.org/10.1080/09602011.2011.618306

*Objective:* The study set out to determine the effects of errorless naming treatment (ENT) and gestural facilitation naming (GES) within the same individual. *Method:* The study was a single participant crossover treatment design with eight individuals who had aphasia and related word retrieval impairments. During the treatment phase all participants had errorless naming treatment and gestural facilitation training. Participants were seen for 2-3 one-hour sessions per week for up to 20 sessions of treatment per phase. Post-testing and follow-up testing took place. *Results/Conclusion:* Both treatments, ENT and GES, resulted in improvements in naming of trained words, offering no difference in naming between treatments. The increased use of gestures after the GES therapy did, however, provide a potential compensatory means of communication when verbal skills did not improve. Both treatments are considered effective to promote recovery of word retrieval. *Relevance:* This study involved scoring responses for accuracy. Clinicians scored the responses online for accuracy of naming and recognizable gesture production. Additionally, a second examiner blind to treatment conditions scored a videotaped response to reliably analyze results. Our research will have to consider methods for determining accuracy of a response.

Warriner, A. B., Kuperman, V., & Brysbaert, M. (2013). Norms of valence, arousal, and

dominance for 13,915 English lemmas. *Behavior Research Methods*, *45*, 1191–1207.

https://doi.org/10.3758/s13428-012-0314-x

*Objective:* The goal of this research study was to establish an extensive list of English words that

had ratings for valence, degree of arousal, and dominance/power of the response associated with

a particular word to be used in research. *Method:* Words were compiled from various sources,

only including words with the highest-frequency of 70% or more familiarity. The stimuli were

distributed over 43 lists containing between 346-350 words each. Participants were given an

assignment to rate the word presented on a single dimension only. *Results/Conclusion:* The study

produced emotion norms for nearly 14,000 words to offer a greater selection of stimulus words

for future research studies. The rating offer values for dimension, arousal, and dominance.

*Relevance:* Our research will review the word list compiled in this research to build our stimuli

materials. We will consider the familiarity and frequency of the word, and its concreteness in

addition to the ratings provided here.

APPENDIX B

**IRB Approved Consent Form**

# Consent to be a Research Subject

...........................................................................................................................................

**<u>Introduction</u>**
This research study is being conducted by Tyson Harmon, Ph.D., CCC-SLP at Brigham Young University. The purpose of this study is to determine how positive and negative emotions affect naming in aphasia. You were invited to participate because you have aphasia, which affects your ability to find words.

**<u>Procedures</u>**
Your participation in this study will involve a **single session** lasting **1.5 to 2 hours**. During the session, you will be asked to complete screenings, tests and questionnaires, and an experimental protocol.

The screening, tests, and experiment will involve:

| | | |
|---|---|---|
| **Screening** | Hearing screen | |
| | Vision screen | |
| **Tests and Questionnaires** | Language test | |
| | Naming test | |
| | Mood questionnaire | |
| **Experiment** | View and name pictures | |
| | Answer questions | |

During the experimental task, you will see and name a variety of pictures, some of which have been designed to make you feel happy or sad. You will have sensors placed on your wrists and finger to monitor your heart rate and sweat glands. We will also ask you to occasionally answer two questions about how you feel. You can choose whether the evaluation session is held in your home or the Aphasia Lab on BYU campus (John Taylor Building room 111).

**Medical Records**

Strokes and brain injuries can affect different areas of the brain. With your authorization, we would like to obtain **medical records** to help us describe what area of your brain was damaged.

_____**YES** _____**NO** I give the study investigators permission to request copies of previous brain scans.

**Video Recordings**

Several tests and the experimental naming task will be **video recorded** to check scores and complete more detailed analysis after the session. Please indicate what uses of these recordings you are willing to permit, by initialing next to the uses you agree to and signing at the end. This choice is completely up to you. We will only use the video in the ways that you agree to. In any use of the video, you will not be identified by name.

_____**YES** _____**NO** Video recordings can be studied by the research team for use in the **research project**.

_____**YES** _____**NO** Short excerpts of video recordings can be used for **scientific publications, conferences, or meetings**.

_____**YES** _____**NO** Short excerpts of video recordings can be shown in **university classes**.

**Risks/Discomforts**

During the experiment, you will see several **pictures that are designed to create an emotional response** (e.g., make you feel happy or sad). Examples of pictures designed to make you feel sad include scenes of natural disasters such as fires or tornadoes, injured animals, and explosions. Examples of pictures designed to make you feel happy include beautiful vistas, cute and content animals, and celebrations. For some people, these pictures may cause emotional distress. Some of the test items may also be difficult for you causing you to become frustrated, tired, or embarrassed. **You can take a break or discontinue your participation at any time.**

**Benefits**

Since this is not a treatment study, there is likely no direct benefit to you. However, your participation in this study will provide us with information that might generally improve assessment and treatment of people with aphasia.

**Confidentiality**

All **data** collected for the purposes of this study will be **kept confidential** and will only be

reported without personally identifiable information. Any personally identifiable information will be stored separate from research data in a locked cabinet in the researcher's office.

You will be given a number that will identify you for this study. All data obtained from you will be associated with this number instead of your personally identifiable information. Any paper forms or test protocols will be kept in locked cabinets in a locked research lab at BYU. Any electronic forms or files (e.g., video files) will be kept on a secured, password protected server. Only those directly involved with the research will have access to these data.

**Compensation**
You will receive a **$15 gift card** after completing the session.

**Participation**
Participation in this research study is **voluntary**. You have the right to withdraw at any time or refuse to participate entirely. You do not have to be in this study to receive clinical services through the BYU Speech and Language Clinic. Choosing to not participate will not jeopardize your services at BYU or any other healthcare service you receive.

**Questions about the Research**
If you have questions regarding this study, you may contact Tyson Harmon, Ph.D., CCC-SLP by phone at 801-422-1251 or email at tyson_harmon@byu.edu.

**Questions about Your Rights as Research Participants**
If you have questions regarding your rights as a research participant contact IRB Administrator at (801) 422-1461; A-285 ASB, Brigham Young University, Provo, UT 84602; irb@byu.edu.

**Statement of Consent**
I have read, understood, and received a copy of the above consent and desire of my own free will to participate in this study.


Name (Printed): _____ Signature: _____ Date: _____

APPENDIX C

**SAM Ratings**

If you felt completely happy when viewing the pictures, then you can indicate feeling happy by pointing to the figure on the left. If you felt completely unhappy, annoyed, or despaired, you can indicate feeling unhappy by pointing to the figure on the right.
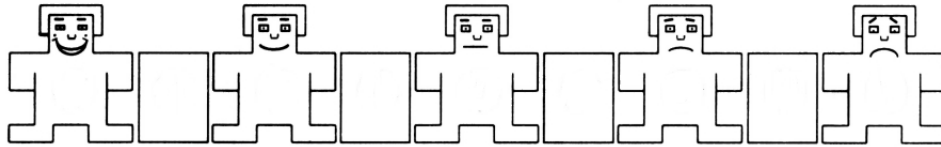


If you felt completely aroused, stimulated, excited, frenzied, jittery, or wide-awake while viewing the pictures, you can indicate feeling aroused by pointing to the figure on the left. If you felt completely relaxed, calm, sluggish, dull, sleepy, or unaroused, you can indicate feeling unaroused by pointing to the figure on the right.
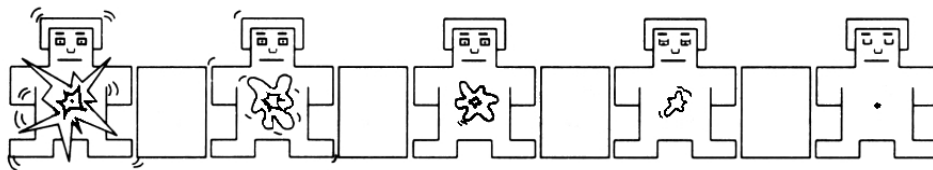
APPENDIX D

**Stimuli**

| Neutral 1 | Positive | Neutral 2 | Negative | Neutral 3 |
|---|---|---|---|---|
| cup | gold* | clarinet* | bomb | oar |
| elbow | wedding | pen | witch | box |
| chair | breakfast | rock | tornado | tie |
| newspaper | beach | foot | (hurricane) | cross |
| suit | dance | shirt | mosquito | nail |
| dustpan | candy | monk (friar, | hospital | forehead |
| hole | chocolate | priest) | rat | cube (box) |
| chalk* | star | table | gun | compass |
| card (8 of heart) | swimming | match | ambulance | cow |
| pigeon (bird) | money | hay | punch | toe |
| spatula | fairy | lock | traffic* | stool |
| camel | (video) game | jar | cry | pan |
| nun | leopard (cheetah) | dresser (drawer) | skunk | pencil |
| rice | kiss | beard | devil | chess |
| tire | football | sheep | bee | door |
| net | queen | straw | spider | envelope |
| desk | mermaid | fence | robber | accordion |
| cane | cake | lungs | whip | lamp |
| apron | tiger | seal | angry* | moth |
| nose | music | shoe | bullet | typewriter |
| | | asparagus | poison (alcohol) | |

* indicate items that were excluded

Parenthesis indicate acceptable alternative responses

APPENDIX E

**Individual Participant Accuracy Graphs**
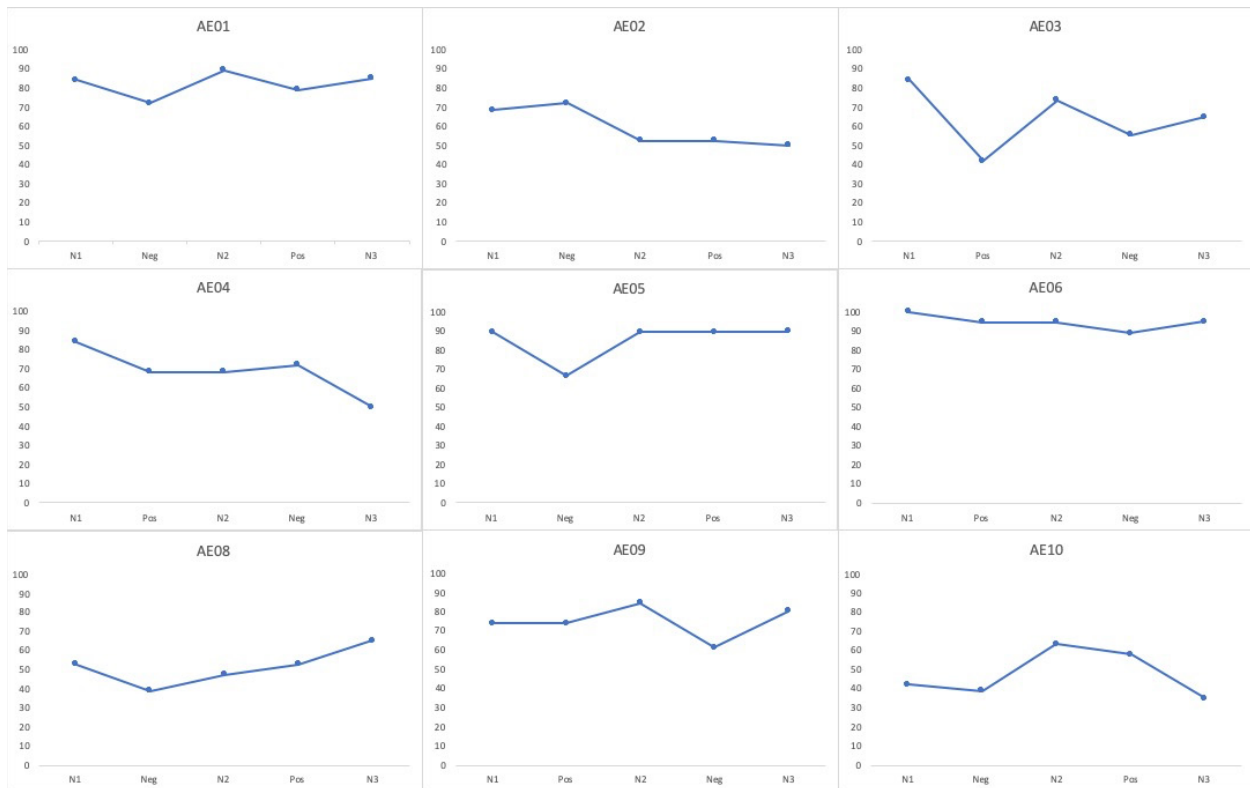


Note: y-axis = % accurate; x-axis = condition (i.e., N1 = neutral 1, Neg = negative, N2 = neutral 2, Pos = positive, and N3 = neutral 3)