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Effects of Positive and Negative Emotional Valence on Response TimeDuring a Confrontational Naming Task: Findings from People with Aphasia and Young Adults

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Master of Science

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ABSTRACT

Effects of Positive and Negative Emotional Valence on Response Time During a Confrontational Naming Task: Findings from People with Aphasia and Young Adults

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The purpose of the current study was to determine the effect of emotional arousal and valence on linguistic processing of adults with aphasia and neurotypical young adults. Nine people with aphasia (at least 6 months left hemisphere stroke and presenting with word retrieval deficits) and 20 young adults (reporting no evidence of neurological injury) participated. All participants completed a confrontational naming task during three conditions that were manipulated according to emotional arousal and valence: positive (high arousal, positive valence), negative (high arousal, negative valence), and neutral (low arousal, neutral valence). Average response time was measured for pictures named accurately within each condition. In general, participants with aphasia named pictures more slowly than young adult participants. Neither participant group had significant differences in response time across conditions. Individual participants varied in how emotional valence affected their response times. Further research is needed to identify what factors lead to differing responses to the high-arousal conditions.

Keywords: aphasia, response time, rehabilitation, naming, valence, arousal patterns

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DESCRIPTION OF THESIS STRUCTURE AND CONTENT

This thesis, *Effects of Positive and Negative Emotional Valence on Response Time During a Confrontational Naming Task: Findings from People with Aphasia and Young Adults,* is written in a journal-formatted structure. This thesis is part of a larger study regarding the effect of emotion valence and arousal on people with aphasia. The annotated bibliography is included in Appendix A, consent form for participants in Appendix B, stimuli used for the confrontational naming task in Appendix C, and Self-Assessment Manikin (SAM) pleasure and arousal forms in Appendix D.

Introduction

Aphasia is an acquired neurogenic language impairment that affects approximately two million people in the United States (approximately 40% of stroke survivors; Code & Petheram, 2011). Among other deficits, people with aphasia exhibit impaired word retrieval and delayed linguistic processing, which interfere with their interpersonal communication, social engagement, vocational success, and participation in pre-injury activities (Worrall et al., 2016). Despite impaired language, most people with aphasia maintain the ability to process emotions (Landis, Graves, & Goodglass, 1982; Ramsberger, 1996; Reuterskiold, 1991). The present study investigated how emotion affects speed of linguistic processing for people with aphasia during a confrontational naming task.

Core Deficits and Intact Functions

While aphasia therapy approaches may be dichotomized as impairment-based or compensatory, many successful therapies target core deficits while also capitalizing on intact functions (Bakhtiyari et al., 2015; World Health Organization, 2001). One ubiquitous core deficit in aphasia is anomia, often manifest through increased word errors and slower processing time during confrontational naming tasks (Hamberger & Seidel, 2003; Nickels, 2002). During confrontational naming, the person with aphasia names a presented picture targeting an object/action word. Repetitive practice of confrontational naming leads to an increased ability to retrieve both phonological and orthographic word forms, improving speaking and writing (Deloche, Dordain, & Kremin, 1992). This improvement has led to confrontational naming being utilized in a variety of intervention approaches (e.g., Semantic Feature Analysis, Verb Network Strengthening, and Voluntary Control of Involuntary Utterances; Boyle, 2004; Edmonds & Babb, 2011; Helm-Estabrooks & Albert, 2004).

Anomia is often measured in assessment batteries and treatment approaches according to accuracy; however, response time (RT) is also important. The RT is a measure of the duration between the presentation of a stimulus and an individual's reaction to it. During word retrieval, RT provides information regarding the speed of linguistic processing. People with aphasia show delayed RT during confrontational naming tasks when compared to neurotypical peers, indicating word-finding difficulties (Galletta & Goral, 2018). Although aphasia treatments that target improved naming have traditionally focused on outcomes related to accuracy (Helm-Estabrooks & Nicholas, 2000; Kendall, Oelke, Brookshire, & Nadeau, 2015; Rochon, Laird, Bose, & Scofield, 2005), recent research suggests that focusing on both improved accuracy and shorter RTs is critical for generalization to connected speech (Conroy, Drosopoulou, Humphreys, Halai, & Lambon Ralph, 2018).

Although anomia is prevalent in aphasia, other functions can remain relatively intact (e.g., automatic speech, melody, rhythm, and intonation). Because aphasia is most often the result of damage to the left frontotemporal portion of the brain, many of these intact functions are in spared cortical regions. Taking advantage of intact functions in both assessment and treatment can facilitate functional communication across multiple contexts (Bakhtiyari et al., 2015) and help therapy be more enjoyable (Holland, 1991). Examples of therapy approaches that rely on spared functions include Voluntary Control of Involuntary Utterances (VCIU; Helm-Estabrooks & Albert, 2004), Response Elaboration Training (RET; Kearns, 1986), and Melodic Intonation Therapy (MIT; Albert, Sparks, & Helm, 1973). Some approaches, such as VCIU and RET, rely on spared automatic speech to elicit propositional speech and expand verbal productions. Another approach, MIT, was designed to rely specifically on intact functions thought to be processed in the right hemisphere (i.e., melody, rhythm, and linguistic stress) to facilitate verbal language output (Norton, Zipse, Marchina, & Schlaug, 2009). Another function that seems to remain relatively intact in people with aphasia is the processing of emotion.

Emotion and Language Processing in Aphasia

In addition to melody and rhythm, the right cerebral hemisphere is suggested to play an important role in processing emotion. As evidence for this, Cicero et al. (1999) found that participants with right hemisphere brain damage produced more incorrect responses on both an emotion word task and a sentence identification task (i.e., naming the emotion described by a cluster of three words or in a sentence) than both participants with left hemisphere brain damage and neurotypical controls. In another study, Zgaljardic, Borod, and Sliwinksi (2002) assessed right and left hemisphere brain-damaged individuals' ability to recover emotion processing post-stroke compared to neurotypical controls' ability to process emotion. Individuals received baseline testing and two-year follow-up testing regarding facial perception of emotion, prosodic perception of emotion, and lexical perception of emotion. Participants with right brain damage received lower scores at baseline and at follow-up testing across all emotion identification tasks. These behavioral findings suggest that the right hemisphere has an important role in processing emotion.

Due to the role of the right hemisphere in processing emotion, the effect of emotion on language recovery for people with aphasia is important to investigate (Landis et al., 1982; Ramsberger, 1996; Reuterskiold, 1991). The notion that emotion is spared in people with aphasia has been around for more than a century (Jackson, 1868) and over the past decades has begun to be substantiated empirically (Landis et al., 1982; Lorch, Borod, & Koff, 1998; Ramsberger, 1996; Reuterskiold, 1991). Anecdotal evidence from clinicians has coincided with the emergence of research reporting that people with aphasia have the ability to produce propositional speech or utter expletives during high emotion situations (Landis et al., 1982). However, this evidence has mostly focused on the effects of arousal and measures of accuracy, but valence and RT are also important to consider. Arousal refers to the strength of the emotion (i.e., high or low) and valence refers to the direction of the emotion (i.e., positive or negative).

Initial studies looking at the effect of emotion on language in people with aphasia found it facilitated increased accuracy during reading, writing, comprehension, and repetition tasks. Landis et al. (1982) studied the effect of emotion on reading and writing in individuals with aphasia. The authors reported that participants read abstract emotion words more accurately than abstract nonemotion words. Later, Reuterskiold (1991) reported people with aphasia participated in an auditory single word discrimination task; a stimulus word was read aloud by a presenter and the participants chose the matching picture from an array of seven. People with aphasia identified the words with high emotion better than neutral words. The authors concluded that performance on linguistic tasks could be improved when stimulus material is emotionally arousing. Ramsberger (1996) studied verbal repetition of emotion and nonemotion words, presented from a recording, from people with aphasia. Participants improved in their language performance during repetition of emotion vs. nonemotion words. Cicero et al. (1999) instructed participants to read a sentence and identify which of eight lexical categories best described the emotion present. People with aphasia performed significantly better when the sentence categories were emotional compared with nonemotional. Similarly, electrophysiological findings suggest more similar neural activation patterns for participants with aphasia compared with neurotypical controls when processing emotion vs. neutral words (Ofek et al., 2013). Thus, a convergence of behavioral and neurophysiological evidence suggests that emotion may lead to more typical linguistic processing for people with aphasia, which could help compensate for impaired language.

Although these studies support emotion facilitating language for people with aphasia, they have limitations, which lead to further questions. First, word stimuli were controlled for some linguistic variables (i.e., length of the word) but not others. For example, Ramsberger (1996) controlled stimuli for frequency of occurrence, but not for additional linguistic factors that influence word processing such as imageability and familiarity. Second, two studies lacked information about the source of emotion word lists, making differences difficult to ascertain (Landis et al., 1982; Reuterskiold, 1991). In both cases, researchers developed their own emotionality ratings for stimuli by having neurotypical adults rate the arousal of words from a predetermined emotion list. The authors then used the words with ratings that were most arousing. No information was reported on the development of nonemotion word lists. Third, these same two studies considered emotional arousal but not valence (Landis et al., 1982; Reuterskiold, 1991). When looking at the word sets used in the study by Landis et al. (1982), words described by the author as "emotional" mostly appear to be of a negative valence (i.e., fear, kill, pain, love, dead, hate, rage, weep, slap, stab, rape, and nude). When valence was considered, as in Ramsberger (1996), word stimuli were not blocked to limit carryover effects. Lastly, no studies used a confrontational naming task, despite its relevance to assessment and treatment as well as its ecological validity (Hamberger & Seidel, 2003; Khatoonabadi et al., 2015; Ramsberger, 1996).

The faciliatory effect of emotion on language in aphasia is consistent with the Right Hemisphere Hypothesis (RHH), but the design of previous research has precluded the consideration of a competing hypothesis (i.e., the Valence Specific Hypothesis [VSH]). The

RHH suggests that emotion processing occurs in the right hemisphere, regardless of valence (Cicero et al., 1999; Landis, 2006). This implies that high-arousal stimuli, both of positive and negative valence, would improve linguistic processing for people with aphasia.

The Valence Specific Hypothesis (VSH) posits that each hemisphere of the brain is specialized for processing a specific valence: right hemisphere for negative emotion and left hemisphere for positive emotion (Hielscher-Fastabend, 2015). Primary evidence for this hemispheric specialization relies on the information that many patients with aphasia, due to left hemisphere lesion, experience symptoms of depression and anxiety (Hielscher-Fastabend, 2015). However, the question of valence has rarely been considered in studies that investigate the effects of emotion on language processing in aphasia. Three studies using neurotypical adults, on the other hand, have supported this hypothesis (Briesemeister, Kuckinke, & Jacobs, 2011; Duda & Brown, 1984; Jansari, Tranel, & Adolphs, 2000). Authors of one study reported when neurotypical adults were presented with either a happy or sad facial expression at the same time as a neutral facial expression, RT was faster when naming the positive facial expression in the right visual field and negative facial expression in the left visual field. Due to the bilateral nature of visual processing in the brain, this suggests that the left hemisphere might be specific to processing positive valence and the right hemisphere to processing negative valence (Duda & Brown, 1984; Jansari et al., 2000). Another study separated stimuli based on valence (Briesemeister et al., 2011). In this study, neurotypical adults completed a lexical decision task where they identified presented stimuli as either a word or nonword. The authors found that valence did impact RT; participants responded faster to positive valence words compared with neutral words and faster to neutral words compared with negative valence words. If individuals with aphasia responded to emotion as described in the VSH, they would have improved linguistic processing for high-arousal positive but not the high-arousal negative emotion.

Distraction Theories (DT) offer a third possibility for how emotion might affect language processing. The DT suggests that high-arousal emotions, regardless of valence, increase task attention demands, leading to a slower processing time (DeCaro, Thomas, Albert, & Beilock, 2011). While many studies use comprehension and repetition tasks to evaluate the effect of emotion on linguistic processing, authors in another used confrontational naming (Blackett, Harnish, Lundine, Zezinka, & Healy, 2017). The RT was measured while neurotypical adults named positive, negative, and neutral emotion-laden images. The authors reported RT to be significantly slower for both positive and negative images compared to neutral images. There was no significant difference between positive and negative images, indicating that emotion processing was slower for emotion words, regardless of valence. The authors hypothesized that it was difficult for participants to disengage attention from the emotional aspects of the picture, therefore slowing RT. Although this study did not include people with aphasia, it is feasible that participants with aphasia become distracted from a language task when emotions are high. This would be supported by the evidence that people with aphasia slow down and pause more when producing discourse under social stress (Cahana-Amitay et al., 2011; Harmon, Jacks, Haley, & Bailliard, 2020).

In conclusion, there is substantial evidence that the right hemisphere plays a role in processing emotion. Differing theoretical perspectives suggest emotion may facilitate linguistic processing for people with aphasia when emotion arousal is increased generally (RHH) or for negative valence conditions specifically (VSH). However, emotion may interfere with linguistic processing by diverting attentional resources from the language task (DT).

Purpose of the Present Study

The effect of emotion on RT for people with aphasia during a confrontational naming task has not been previously examined. This research study contributes to knowledge of the impact of emotion on language processing in adults with aphasia and neurotypical young adults. Understanding the effect of emotion on naming in aphasia may facilitate better maintenance and generalization in intervention addressing word finding abilities. The purpose of this study is to examine the differences in RT (a) for people with aphasia when naming positive, negative, and neutral pictures and (b) between people with aphasia and neurologically healthy young adults when naming positive, negative, and neutral pictures. This study will address the following research hypotheses:

1. People with aphasia will have a slower response time compared to neurologically healthy participants.
2. Neurologically healthy participants will have a slower response time when naming positive and negative words in comparison to neutral words.
3. People with aphasia will have a faster response time when naming positive and negative words in comparison to neutral words.

Method

This thesis was part of a larger research project analyzing the effect of emotion on confrontational naming in people with aphasia. This project employed a repeated measure design examining RT during different emotional conditions. The Brigham Young University (BYU) Institutional Review Board approved the study and all participants consented to be research subjects.

Participants

This study included nine adults with aphasia and 20 neurotypical young adults. All participants were over 18 at the time of testing, primary English speakers, and passed a vision/hearing screening. Participants with aphasia were included based on (a) evidence of damage localized to the left cerebral hemisphere, (b) aphasia according to the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2006), (c) score of 80% or below on the Boston Naming Test (BNT; Goodglass, Kaplan, & Weintraub, 1983), and (d) at least six months post-onset. Eight candidates from the present study previously participated in research through the BYU Aphasia Lab and had agreed to be contacted for future studies. Participants from the young adult group were included based on reporting no symptoms of previous stroke/TIA.

Setting

Data collection took place at the BYU Aphasia Research Lab, at the participant's home, or in a shared community space, depending on preference. When in the participant's home, efforts were made to limit distractions by finding a quiet, secluded area for testing. In all settings, participants were seated at a table and viewed pictures displayed on a MacBook Pro via Microsoft PowerPoint. Each session was audio-video recorded using either the "Photobooth" application on the MacBook Pro, a Canon Vixia HF R80, or a HFR21 camera with a Sony ECM-AW4 microphone.

Stimulus Development

Positive, negative, and neutral word lists were derived from a previously reported corpus of words rated for valence and arousal on a scale of 1 to 9 (Warriner, Kuperman, & Brysbaert, 2013). Based on previous research (Bauerly & Paxton, 2017; Berrin-Wasserman, Winnick, & Borod, 2003; Blackett et al., 2017), positive words were defined as those with an arousal rating greater than or equal to 5 and a valence rating greater than or equal to 6. Negative words were defined as those with an arousal rating greater than or equal to 5 and a valence rating less than or equal to 4. Neutral words were defined as those with an arousal rating less than or equal to 3.2 and a valence rating between 4 and 6. See Figure 1 for word stimuli ratings of valence and arousal.

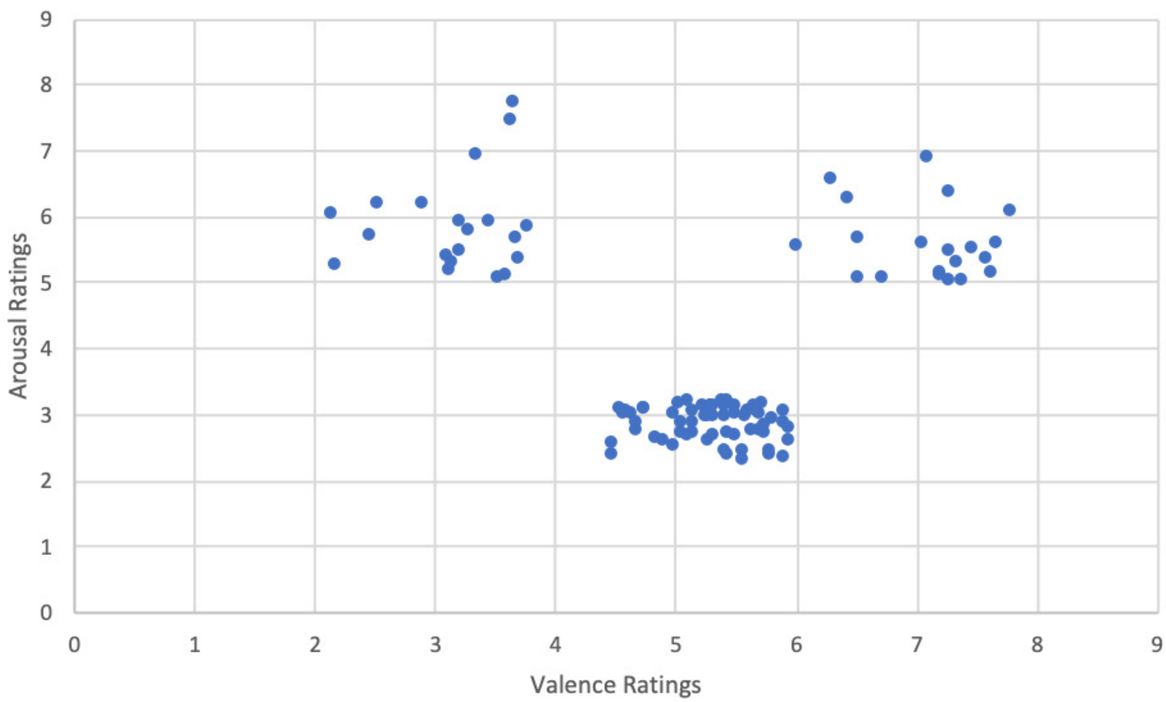

Figure 1. Word stimuli valence and arousal.

Concreteness, familiarity, imageability, frequency, and articulatory complexity values were obtained for all possible words from the previously developed lists. Concreteness, familiarity, and imageability ratings were acquired from the Medical Research Council (MRC) Psycholinguistic Database (Coltheart, 1981). Concreteness ratings for words not included in the MRC database were supplemented from a list of concreteness ratings for 40,000 English word lemmas (Brysbaert. Warriner, & Kuperman, 2014) and imageability ratings not included in the MRC database from the Bristol norms list (Stadthagen-Gonzalez & Davis, 2006). Frequency ratings were derived from the BYU iWeb corpus (Davies, 2018). Articulatory complexity was determined using the Word Complexity Measure (Stoel-Gammon, 2010).

All words that had ratings for all five variables (i.e., concreteness, imageability, familiarity, frequency, and articulatory complexity) were matched with simple black and white images for naming. Pictures were obtained from the International Picture-Naming Project (IPNP; Szekely et al., 2004) and royalty free clip art websites (i.e., vectorportal.com and clipart-library.com). Informal testing (i.e., asking young adults to name presented pictures) determined which pictures could be named accurately. Some images were modified so the target word would be clearer (e.g., arrows added to the picture). Pictures were chosen to be included in the experiment that were consistently named accurately. Images were then controlled for linguistic variables (i.e., concreteness, familiarity, imageability, frequency, and articulatory complexity). The words were grouped into five-word lists. ANOVAs revealed no statistically significant difference between the word lists in ratings of concreteness, familiarity, imageability, frequency, or articulatory complexity ($p > .05$). Table 1 reports means and standard deviations from the five-word lists used in the study (20 positive, 20 negative, and three sets of 20 neutral).

Colored images were selected from the Open Affective Standardized Image Set (OASIS) to reinforce the emotional state of the target images presented in each condition (Kurdi, Lozano, & Banaji, 2017). Two colored images from the OASIS set were randomly assigned for every black and white target image.

Table 1

M (SE) of Emotion and Linguistic Variables Across Five Stimulus Word Lists

Stimulus List	Arousal	Valence	Concreteness	Familiarity	Imageability	Frequency	Articulatory Complexity
	2.86	5.38	584.6	531.35	565.05	450,348	2.9
Neutral 1	(0.05)	(0.09)	(8.01)	(13.99)	(8.76)	(139,817)	(0.27)
	5.58	7.09	554	547.9	595.8	909,363	3.2
Positive	(0.12)	(0.11)	(11.44)	(14.06)	(9.02)	(258,962)	(0.34)
	2.75	5.28	589.8	536.4	581.45	436,696	3.2
Neutral 2	(0.06)	(0.09)	(5.73)	(11.51)	(7.53)	(121,774)	(0.38)
	5.87	3.18	554.9	524.15	579.7	276,645	3.35
Negative	(0.17)	(0.11)	(22.46)	(9.4)	(10.51)	(81,406)	(0.37)
	2.92	5.24	589.5	531.65	582.65	362,853	2.95
Neutral 3	(0.05)	(0.09)	(6.88)	(13.07)	(6.8)	(128,173)	(0.35)

Note. Arousal and valence rated on a scale from 1 to 9; Concreteness rated on a scale from 100 to 700; Familiarity rated on a scale from 100 to 700; Imageability rated on a scale from 100 to 700; Frequency accounts for the number of times the word appears across 94,391 websites (see Davies, 2018); Articulatory complexity scores are based on a combination of articulatory features (see Stoel-Gammon, 2010) with higher scores indicating more complex articulatory movements.

Procedure

The research sessions consisted of two parts; a pre-experimental evaluation and an experimental session. Research sessions were administered by research assistants trained in supportive communication for aphasia.

Pre-experimental evaluation. The pre-experimental evaluation verified qualification for this study while also assessing mood, speech, and language function. As part of the pre-experimental evaluation, all participants completed a hearing and vision screening, the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986), and Dynamic-Visual Analogue Mood Scale (D-VAMS; Barrows & Thomas, 2017). In addition, participants with aphasia completed the

WAB-R (Kertesz, 2006), subtests 6 and 7 of the Test of Everyday Attention (TEA; Robertson, Ward, Ridgeway, & Nimmo-Smith, 1996) and the BNT (Goodglass et al., 1983). Young adult participants completed the Questionnaire for Verifying Stroke-Free Status (QVSFS; Jones, Williams, & Meschia, 2001).

Hearing was screened using an audiometer between 25 dB and 40 dB at the following frequencies: 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. All participants passed with the exception of a mild high frequency hearing loss in AE04 and AE08. AE04 heard the tone in the left ear at 60 dB at 2000 Hz and 65 dB at 4000 Hz. AE04 heard the tone in the right ear at 50 dB at 4000 Hz. AE08 in the right ear did not respond to the tone at 4000 Hz.

In addition to a hearing screening, all participants completed a vision screening. Since the experimental session required participants to view pictures on a screen, this provided information regarding visual field perception. All participants passed, with mild hemianopia present in AE06, AE08, and AE09. AE06 did not respond to stimulus in the upper and lower R side of the R eye; AE08 did not respond to stimulus in the upper and lower L side of R eye; AE09 did not respond to stimulus in the upper and lower R side of R eye.

The WAB-R was a standardized assessment that indicated type and severity of aphasia. Subtests 6 and 7 of the TEA, a standardized assessment, were administered to provide information regarding sustained attention. The BNT was another standardized assessment that provided further insight regarding participants' naming and word finding abilities. Participants with aphasia were included for the test if they received a BNT score of 13 or less. Due to not meeting qualification criteria, AE07 was not included. The young adult group completed the QVSFS to ensure stroke-free status. See Table 2 for demographic and assessment information of participants with aphasia and Table 3 for demographic information of the young adults.

Table 2

Participants with Aphasia Demographic and Assessment Information

PptID	Sex	Age	TPO (yy;mm)	Handedness	WAB-AQ	WAB Type	TEA 6	TEA 7	BNT% Correct
AE01	M	52	6;01	R	81.8	Anomic	4.74	9.83	80
AE02	M	62	9;0	R	34.2	Broca's	9.25	190.93	20
AE03	F	64	7;07	R	62	Broca's	6.45	4.07	27
AE04	M	76	3;01	R	60.3	Wernicke's	6	2.56	60
AE05	F	40	1;01	R	83.4	Anomic	3.6	7.3	80
AE06	M	42	6;06	R	85.9	Anomic	5.4	10.1	73
AE08	M	58	14;10	R	66	Broca's	5.3	13.33	27
AE09	F	48	16;04	L	68.8	Broca's	5.1	13	80
AE10	M	34	5;11	R	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

Experimental session. After completion of the pre-experimental protocol, participants began the experimental session. Participants were instructed to name designated pictures on a computer screen "as quickly and accurately as you can using only one word." Initially, participants learned the test protocol with practice stimuli until understanding of the task was demonstrated. After completion of the pre-experimental protocol, participants began the experimental session. The experimental session consisted of a confrontational naming task with positive, negative, and neutral conditions. Within each condition, participants viewed two OASIS colored images for 6 s before each black and white image. Participants looked closely at each colored image for the full duration but did not name them. Following the colored images, a 1000 Hz tone indicated the following black and white image should be named. These black and

Table 3

Young Adult Demographic and Assessment Information

PptID	Sex	Age (yy;mm)	QVSFS
AEp01	F	21;4	0
AEp02	M	23;9	0
AEp03	F	24;1	0
AEp04	M	21;11	0
AEp05	M	21;11	0
AEp06	M	23;9	1
AEp07	M	22;11	0
AEp08	F	22;1	0
AEp09	F	22;7	0
AEp10	F	23;5	0
AEp11	M	20;0	0
AEp12	F	22;1	0
AEp13	F	25;7	1
AEp14	M	21;2	0
AEp15	M	22;5	0
AEp16	F	22;11	0
AEp17	M	27;0	0
AEp18	F	22;3	0
AEp19	M	21;2	0
AEp20	F	26;11	0

Note. QVSFS = Questionnaire for Verifying Stroke-Free Status; A QVSFS score of 0 indicates no symptom with a number score correlating to the number of symptoms experienced associated with neurological disease. AEp06 reported experiencing “sudden numbness or a dead feeling on one side of your body” and AEp13 “suddenly losing one half of your vision.”

white target images were consistent with the emotional arousal and valence of the colored images and represented word lists that were controlled for concreteness, familiarity, imageability, frequency, and articulatory complexity. The black and white images were presented until named or until 30 s had elapsed (Khatoonabadi et al., 2015), whichever came first.

After the practice portion, participants named pictures across five conditions; neutral 1, positive, neutral 2, negative, and neutral 3. The high-arousal condition sets (i.e., positive and negative) were always surrounded by neutral 1, neutral 2, and neutral 3 stimuli. Participants were randomly assigned one of two possible condition sequences: positive as the first high-arousal condition and negative as the second, or negative as the first high-arousal condition and positive as the second. Between each condition, participants had a three-minute waiting period. This allowed participants to return to their baseline emotional state and reduced carryover effects between conditions.

Immediately following each condition and prior to the three-minute waiting period, participants completed a Self-Assessment Manikin (SAM; Bradley & Lang, 1994). Using paper and pencil, this assessment was a self-reported rating of valence and arousal. The SAMp rating, measuring valence, depicted faces ranging from happy to unhappy. Participants were instructed to indicate feeling “happy” by placing an X on the figure on the far left. Participants could indicate feeling “unhappy, annoyed, or despaired” by placing an X on the figure on the far right. If they felt something in-between, they could place an X on a middle figure. The SAMa rating, measuring arousal, depicted a range of arousal from wide eyed to relaxed and sleepy. Participants were instructed to indicate feeling “completely aroused, stimulated, excited, frenzied, jittery, or wide-awake while viewing the pictures” by placing an X over the figure on the far left. If they felt “completely relaxed calm, sluggish, dull, sleepy, or unaroused,” they indicated by placing an X over the figure on the far right. If they felt something in-between, they could place an X on a middle figure.

Measures

For this study, RT was measured from the offset of the auditory stimulus to the onset of the initial phoneme of the correct response as judged by the Philadelphia Naming Test criteria (PNT; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997). Video recordings of the experimental sessions were converted into WAV audio files and analyzed for RT using Praat (Boersma & Weenink, 2020). If participants did not respond correctly to the stimulus, the RT measurement for that picture was not included in data analysis. Participants had up to thirty seconds to respond before being scored as a no response. Five words were disqualified due to the young adult group not naming them with 85% accuracy (i.e., neutral 1: chalk, positive: gold, neutral 2: clarinet, negative: traffic and angry). The first author completed all RT measures and remeasured 20% of data. Intra-rater reliability was 99.89%. A student research assistant was trained to measured RT for 20% of the data. Inter-rater reliability was 99.96%.

Data Analysis

This study used a within-subject repeated measure design to compare scores across groups and conditions. SAMa and SAMp data met assumptions for normality and homogeneity of variance. Two-way mixed effects ANOVAs were used to investigate main effects of group and condition. Significant condition effects were followed up by Tukey’s HSD (honestly significant difference). In addition, the repeated measure design allowed the examination of individuals performance across conditions (i.e., positive, negative, and neutral).

Results

The data were analyzed based on the hypotheses that (a) participants with aphasia would have slower response times compared to neurologically healthy participants, (b) neurologically healthy participants would have slower response time when naming positive and negative words compared to neutral words, and (c) people with aphasia would have faster response time when naming positive and negative words compared to neutral words. In addition to these hypotheses, differences in SAM arousal and valence ratings were analyzed. All SAM and RT analyses will be discussed below. Table 4 reports descriptive statistics of SAM ratings for participants with aphasia and the young adult group.

Table 4

M (SE) of SAM Arousal and Valence Ratings by Young Adults and People with Aphasia

	People with Aphasia		Young Adult	
	SAMa	SAMp	SAMa	SAMp
Neutral 1	5 (1)	7.56 (0.6)	4.1 (0.47)	6 (0.27)
Positive	5.11 (0.77)	6.89 (0.56)	5.6 (0.46)	7.6 (0.29)
Neutral 2	5.22 (0.76)	6.78 (0.43)	3.5 (0.41)	5.3 (0.22)
Negative	6.22 (0.68)	4.67 (0.73)	6.2 (0.51)	3.2 (0.46)
Neutral 3	5 (0.75)	6.56 (0.47)	2.9 (0.4)	5.7 (6.56)

Note. SAMa = Self-Assessment Manikin of Arousal; SAMp = Self-Assessment Manikin of Pleasure

SAM Arousal and Pleasure Ratings

Information was gathered regarding participants' perceived arousal and pleasure following each condition. SAMa data were analyzed using a two-way ANOVA that suggested a significant Group by Condition interaction (F[4,108] = 3.067, p = 0.02). Post-hoc analysis revealed that young adults self-reported significantly higher arousal following the negative condition compared with neutral 1 (p = 0.002), neutral 2 (p = <0.001), and neutral 3 (p = <0.001) conditions. Young adults self-reported significantly higher arousal after the positive compared with neutral 2 ($p = 0.002$) and neutral 3 ($p = <0.001$) conditions.

A two-way ANOVA for SAMp also suggested a significant Group by Condition interaction effect ($F[4,108] = 3.49$, $p = 0.01$). Post-hoc analysis revealed that young adults reported significantly lower pleasure after the negative condition compared with the neutral 1 ($p < 0.001$), neutral 2 ($p < 0.001$), and neutral 3 ($p < 0.001$) conditions. They also reported significantly higher pleasure after the positive condition compared with neutral 1 ($p = 0.005$), neutral 2 ($p = <0.001$), and neutral 3 ($p < 0.001$) conditions. Participants with aphasia self-reported significantly lower pleasure after the negative condition compared with the neutral 1 ($p < 0.001$), neutral 2 ($p = 0.0223$), and neutral 3 ($p = 0.065$) conditions but their pleasure ratings after the positive condition were not significantly different from ratings following the neutral conditions.

RT Measures

It was hypothesized that people with aphasia would have slower RTs compared to neurologically healthy participants. Although RT data did not meet assumption of homogeneity of variance, because ANOVAs are robust to violations of this assumption, the analysis was completed. Two participants completed conditions that were excluded from analysis (i.e., AEp04: Neutral 1 and AEp11: Neutral 1, Negative, and Neutral 2) due to technical difficulties during the experiment. Consistent with our group hypothesis, there was a significant main effect for Group ($F[1,27] = 47.364$, $p = <0.001$). Inconsistent with our condition hypothesis, there was no main effect for condition ($F[4,104] = 0.832$, $p = 0.508$). There was also no Group by Condition interaction effect ($F[4,104] = 1.299$, $p = 0.275$). Figure 2 illustrates RT by condition for both young adults and participants with aphasia.

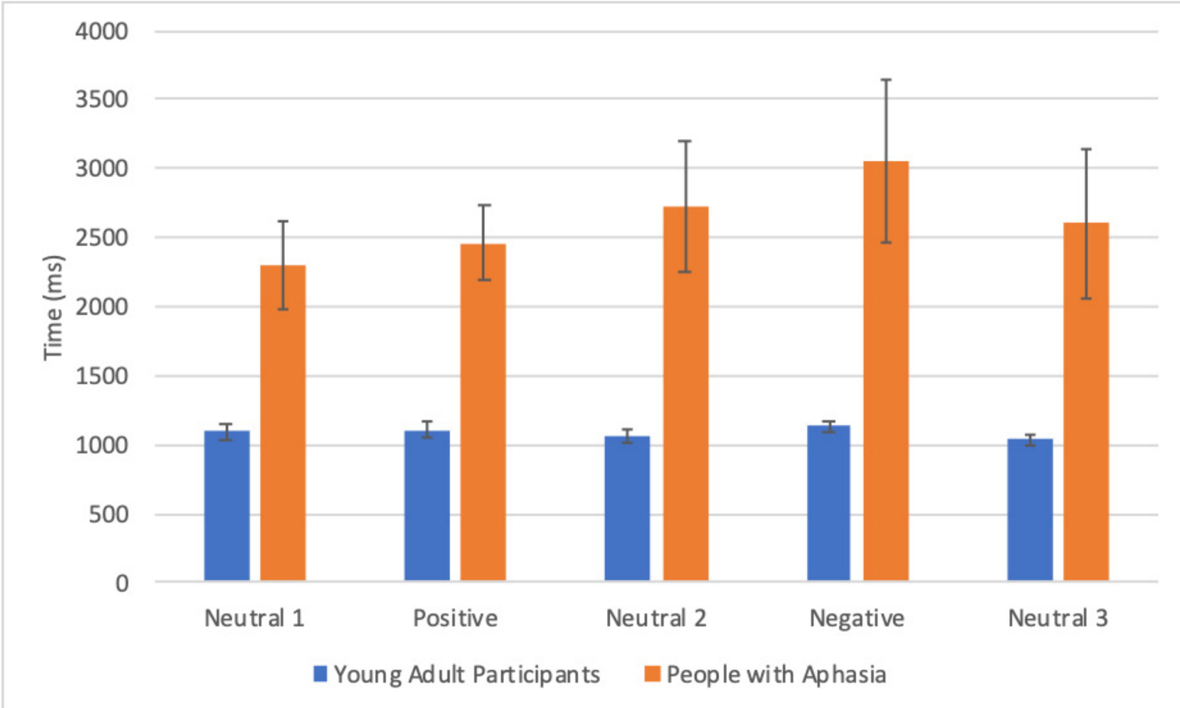

Figure 2. Average response times from young adult and people with aphasia across five conditions. Error bars indicate standard errors.

Individual Measures

Individual participant RTs were visually inspected for condition effects. From the young adult group, four participants (i.e., AEp01, AEp06, AEp07, AEp18) demonstrated slower RTs in the negative condition followed by a return to baseline in the following neutral condition. Three participants (i.e., AEp09, AEp12, AEp19) demonstrated slower RTs in the positive condition with a return to baseline in the following neutral condition. Three participants (i.e., AEp13, AEp14, AEp17) had slower RTs in both the positive and negative conditions, with a return to baseline in the following neutral conditions. The other 10 participants did not demonstrate a condition effect.

Of the nine participants with aphasia, six demonstrated a condition effect in either the positive condition, negative condition, or both. Two participants (i.e., AE03 and AE06) demonstrated faster RTs in one or both of the high-arousal conditions. Participant AE03 had faster RTs in both the positive and negative condition compared with the surrounding neutral conditions. Participant AE06 had faster RTs in only the positive condition compared with the preceding and subsequent neutral conditions. Three participants demonstrated slower RTs in at least one high-arousal condition; AE10, AE04, and AE05: Participant AE10 had slower RTs in both the negative and positive conditions compared to preceding and subsequent neutral conditions; Participant AE04 had slower RTs in the positive condition compared to preceding and subsequent neutral conditions; Participant AE05 had slower RTs in the negative condition compared to preceding and subsequent neutral conditions. Participant AE09 was the only participant that demonstrated a positive condition effect followed by a negative condition effect in the opposite direction; this participant demonstrated slower RTs in the positive condition and faster RTs in the negative condition. Participants AE01, AE02, and AE08 did not demonstrate a condition effect.

Discussion

The two purposes of this study were to (1) determine the effect of emotional arousal and valence on linguistic processing in young adults and people with aphasia during confrontational naming and (2) compare speed of processing as measured by RT between the two participant groups. RT measures revealed no significant changes in speed of naming across conditions for either the young adult or aphasia group. Visual inspection of individual participant RTs revealed that there was variability in how each person reacted to the different high-arousal naming conditions. A secondary aspect of this study was to determine how the young adult and people with aphasia perceived arousal and pleasure based on SAM ratings. The young adult group reported higher arousal after both positive and negative conditions. They also reported lower pleasure after the negative condition and higher pleasure after the positive condition. The participants with aphasia did not report changes in perceived arousal across the conditions and reported lower pleasure ratings after the negative condition only.

The SAM arousal and pleasure ratings provided insight into the self-perceived effect of high arousal positive and high arousal negative conditions. Responses from young adults were consistent with previous research (Bauerly & Paxton, 2017); however, participants with aphasia reported lower pleasure after the negative condition with no other changes in pleasure or arousal. There are two possible explanations for this. First, processing of verbal and/or written language was required to understand the instructions provided for the SAM. Given the language deficits present in the aphasia group, it is possible that they did not fully understand the task. Second, it is possible that during high-arousal conditions, participants with aphasia did not experience psychological or physiological arousal. Recent research suggests that people with aphasia show no cortisol awakening response, as seen in neurotypical adults (Laures-Gore, Cahana-Amitay, & Buchanan, 2019). If people with aphasia do not experience a cortisol awakening response, this would indicate that physiological arousal may be harder for them to achieve. Although the emotion conditions in our study were reportedly arousing for the neurotypical group, it possibly had a different or no effect on the aphasia group.

Despite not reporting changed emotional arousal, participants with aphasia did report lower pleasure after the negative condition. People with aphasia are suggested to be more attuned to negative than positive emotions compared to neurotypical adults (Cahana-Amitay et al., 2011; Harmon et al., 2020). This is evident in elevated levels of stress hormones (Laures-Gore et al., 2019). In particular, language is often linked to stress in this population (Laures-Gore, 2012; Laures-Gore, Heim, & Hsu, 2007). Considering that confrontational naming is a language task, negative feelings could have been exacerbated.

When comparing RT between young adults and participants with aphasia, the young adults named pictures significantly faster. Previous research indicates that young adults have faster RT during a confrontational naming task compared to older adults (Blackett et al., 2017). In our study, young adult participants were significantly younger (M = 22:11) than participants with aphasia (M = 56:7). However, participants with aphasia had response times longer than the older participants in Blackett et al. (2017). This suggests participants with aphasia had slowed linguistic processing despite their older age; their ability to move from the understanding of a concept, retrieve the semantic and lexical forms, and then phonologically encode the target word, was less efficient than the young adult group. This is consistent with previous research reporting that people with aphasia have slower RTs than adults without aphasia (Galletta & Goral, 2018; Hamberger & Seidel, 2003). Similar to the present study, Galletta and Goral (2018) asked neurotypical adults and individuals with aphasia to participate in a confrontational naming task. Participants with aphasia demonstrated slower RTs to concrete and abstract pictures compared to their neurotypical peers. Our findings replicated those in Hamberger and Seidel (2003); participants with left-hemisphere lesions had slower RTs during a confrontational naming task compared to neurotypical controls.

We anticipated young adult participants to demonstrate slower RTs during positive and negative conditions, consistent with findings in Blackett et al. (2017). However, the young adult group had no significant changes in RT across the different conditions. The young adults could have responded differently in our study due to differences in study stimuli. In Blackett et al. (2017) stimuli were from the International Affective Picture System (IAPS). The target words were controlled for valence, arousal, and concreteness, but not familiarity, imageability, articulatory complexity, or frequency. These values have been suggested to affect RT (Davies, 2018; Reuterskiold, 1991; Stadthagen-Gonzalez & Davis, 2006), potentially leading to slower RTs in different emotion conditions. Blackett et al. (2017) discussed the importance of accuracy and measured this variable but then did not report the accuracy measures. Although both studies reported RT, differences in accuracy may also contribute to differing results.

People with aphasia were hypothesized to name high-arousal images faster than low-arousal images and the final results were inconsistent with this prediction. This may be due to the amount of time allowed for responding to images. Active word finding strategies are employed after 1,500 ms; therefore, the greater length of time to respond in our study potentially allowed implementation of deliberate word finding strategies (Galletta & Goral, 2018). Research regarding speed-accuracy trade-offs suggests that faster RTs lead to decreased accuracy and slower response times lead to increased accuracy. However, these relationships are nonlinear; extended RT can lead to diminishing accuracy, while too limited RT can also lower accuracy. During a naming task, the ideal amount of time to give someone with aphasia or a neurotypical control would be determined individually (Evans, Hula, & Starns, 2019). Research with 10 participants with differing severities of aphasia determined optimal cutoff ranges to be between 10 s and 15 s (Evans, Hula, Quique, & Starns, 2020). In addition, length of time to respond to stimuli was suggested to be important by Galletta and Goral (2018); too little as well as too much time to respond might affect results for participants with aphasia during a confrontational naming task.

Although there was no effect for RT based on condition for either the young adult or aphasia groups, some individual participants' RT displayed condition effects. Condition effects were determined by making a line graph of each participant's average RT across all conditions. For a condition effect to occur, high-arousal conditions (i.e., positive or negative) would need to be noticeably faster or slower than the preceding and subsequent neutral conditions. The surrounding neutral conditions displayed similar RT, indicating a baseline had occurred in the neutral conditions. In the young adult group, 50% (10/20) of individual participants demonstrated a condition effect in one or both high-arousal conditions – 30% (6/20) in the positive condition and 35% (7/10) in the negative condition. Of these young adults, the majority (9/10) responded to high-arousal conditions by slowing their RT. These responses are consistent with those in Blackett et al. (2017), indicating that high-arousal emotion was potentially distracting from the confrontational naming task.

Responses from individual participants with aphasia provided support for multiple theories (i.e., Valence Specific Hypothesis, Right Hemisphere Hypothesis, and Distraction Theory), illustrating the heterogeneity of this group, which is characteristic of aphasia research in general (Nilipour, Bakhtiar, Momenian, & Weekes, 2017; Ramsberger, 1996). In support of the Valence Specific Hypothesis, two participants had faster RT in high-arousal conditions (i.e., AE06, AE09) – AE06 in the positive condition and AE09 in the negative condition. In support of the Right Hemisphere Hypothesis, one participant had faster RTs in both high-arousal conditions (i.e., AE03). Supporting the Distraction Theory, three participants with aphasia had slower RTs during one or both high-arousal conditions (i.e., AE10, AE04, AE05).

Despite some individual participants demonstrating responses consistent with different hypotheses, individual variability was prominent across both groups. This high variability could be due to a myriad of factors. The recent research regarding speed-accuracy trade-offs seems to suggest that RT is only one aspect of complex linguistic behavior (i.e., speed of processing) and is difficult to interpret in the absence of accuracy and error data. Additionally, the present study did not exclude participants based on type and severity of aphasia, which affect linguistic processing and create more group heterogeneity (Cicero et al., 1999; Ramsberger, 1996; Zgaljardic et al., 2002). Restricting recruitment to a specific type or severity of aphasia could have reduced some of the heterogeneity seen in the present study.

Limitations and Implications for Future Research

One limitation of this study was the small sample size of participants with aphasia (i.e., 9) and that the young adult participants were not age and gender matched to the aphasia group. Future studies should consider recruiting a larger number of participants with aphasia. Another limitation of this study was the linguistic instruction involved in the SAM. Future studies using the SAM with people with aphasia could consider having aphasia-friendly instructions. Additionally, we did not consider individualizing time allowed for responding to items as has been suggested in recent work (Evans et al., 2019; Evans et al., 2020). This study allowed all individuals with aphasia according to the WAB to participate, where inclusion criteria based on type or severity could be more controlled in future research.

In addition, participants with aphasia did not report significant changes in emotional arousal, either due to misperception or difficulties with physiological arousal. Future studies could consider more directly manipulating the emotional state of people with aphasia and take physiological measures to determine if arousal is achieved between different valence conditions. Used as stimuli in this study, OASIS images were determined for valence and arousal based on neurotypical adults completing image-focused questions, internal-state focused questions, and a 7-point Likert scale for each photo (Kurdi et al., 2017). People with aphasia could complete a similar process to determine if changes in arousal is perceived when presented with single pictures from OASIS images. Another option would be to individualize picture sets based on reports of likes/dislikes or positive/negative associations. Other than stimuli used in a confrontational naming task, physiological arousal could be provoked by incorporating the playing of music, changes in the environment, asking participants questions, or participating in differing tasks. Future experiments could measure physiological arousal, such as heart rate or perspiration, to incorporate understanding of emotional responses.

Conclusion

Previous research suggests that emotion has an effect on linguistic processing. In the present study, RT was measured for young adult and people with aphasia who named pictures in positive, negative, and neutral conditions. Upon individual inspection, half of the participants from the young adult group and a third of the participants with aphasia had slower RTs in one or both high-arousal conditions, supportive of the Distraction Theory. However, RTs were variable and showed no significant main effect for either group. Further research is needed to identify what factors lead participants to respond to high emotional arousal during naming tasks by increasing their linguistic processing. Identifying participants with aphasia who experience this response could lead to tailored therapies that target a participant's emotional response in order to improve language.

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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. doi: 10.1016/j.jfludis.2017.09.006

Objective: This study assessed F2 slope acoustic parameters in response to emotionally charged pictures between adults who stutter and adults who don't stutter. Adults who stutter typically have slower reaction times during high-pressure tasks, and it was hypothesized this decrease in movement would explain a decrease in F2 slope.

Method: During this study, 10 male individuals who stutter and 10 male individuals without a stutter viewed pictures regarding three different emotional states; neutral, high-arousal/positive, and high-arousal/negative. After viewing the picture, the subjects read a string of non-words that were acoustically analyzed. The last task required the subjects to rate their emotional reaction.

Results/Conclusion: The acoustic analysis showed that adults who stutter F2 slopes were steeper and had greater changes in high-arousal conditions than in the control group. These individuals had larger movements in these arousing conditions.

Relevancy: This study suggests that high-arousal stimuli leads to increased gains in muscle movement, indicating individuals with aphasia may experience a reaction to similar stimuli. This study was conducted well and is a model study for the present study. They had well developed stimuli, accounted for carry over effects, and self-perception ratings of emotion.

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,* 429-428. doi: 10.1037/0894-4105.17.3.429

Object: Previous research has shown that emotionality affects memory recall. The aim of this study was to examine the impact emotion content has on individuals with left hemisphere lesions, right hemisphere lesions, and neurotypical controls. Sixteen of the left hemisphere lesion subjects had language deficits.

Method: Stimuli was gathered from the *Handbook of Semantic Word Norms,* a database that has word rated on imageability, familiarity, and valence. Word lists included positive words, negative words, and nonemotional words. Subjects participated in two processing conditions; reading a word then reading aloud a sentence, and reading a word then generating a sentence with the word. There were two retrieval tasks; recall as many words as they could, included in the testing, and recognize included words from a list of words.

Results/Conclusion: After data analysis, there was no difference found between positive and negative emotion stimuli. The data was analyzed with emotion stimuli including both positive and negative. The findings demonstrated that emotion content had the same impact on all the participants; they did better regarding emotion stimuli. Each participant group did better with sentence generation than reading as sentence aloud.

Relevance: This study found that emotion content improves memory recall in participants with left hemisphere, right hemisphere, and normal controls. The subjects with left hemisphere lesions had improved recall, even with language deficits. This implies that in regards to our study, individuals will have better word retrieval with emotional stimuli.

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*, 2081-2089. doi: 10.1044/2017_JSLHR-L-16-0268

Object: The purpose of this study was to determine if high-arousal emotion words affect naming latencies in neurologically healthy adults, as well as naming latency differences in older and younger participants.

Method: During this study, the participants were shown positive, negative, and neutral emotion pictures. They named the pictures, and the response time was recorded.

Results/Conclusion: This study found that positive and negative emotion pictures increased response time in both older and young participants. The difference between positive and negative emotion pictures were not significant.

Relevance: This suggests that if individuals with aphasia behave as neurologically healthy adults, their response time will increase with high-arousal pictures.

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. doi: 10.1044/jshr.3606.1227

Objective: The purpose of this study was to measure verbal pragmatic discourse production regarding three different conditions in right brain-damaged, left brain-damaged, and normal control adults.

Method: The participants were shown a set of cards designed to elicit a response based on emotion, visuospatial, or procedural content.

Results/Conclusion: After pragmatic analysis, the right brain-damaged patients were significantly more impaired regarding emotion discourse, while left brain-damaged patients were more impaired regarding visuo-spatial and procedural discourse. The discourse production was not affected.

Relevancy: This study suggests that emotional aspects of language are spared in left brain-damaged patients.

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. doi: 10.1016/0093-934X(79)90014-2

Objective: The aim of this study was to determine if emotion content and paralinguistic aspects of communication influences auditory comprehension in individuals with aphasia.

Method: Eight individuals with severe aphasia (six with Global aphasia, one severe Wernicke's aphasia, and one with moderately severe Wernicke's aphasia) were presented 60 items. These included high-emotion content, low-emotion content, and neutral content. Stimulus included commands, yes/no questions, and questions requesting information. The responses were scored as correct or incorrect.

Results/Conclusion: The 10 high emotional items produced a greater number of responses and a greater number of correct responses.

Relevance: This study found that emotional content helped those with severe aphasia have more responses. Our study will also elicit a response in those with aphasia, and this study indicates emotional content will increase response and accuracy.

Briesemeister, B. B., Kuchinke, L., & Jacobs, A. M. (2011). Discrete emotion effects on lexical decision response times. *PLoS ONE, 6,* 1-9. doi: 10.1371/journal.pone.0023743

Objective: This study sought to control for valence and arousal, testing the role of discrete emotions (i.e., happiness, neutral, fear, anger, and disgust), emotions that are recognized widespread.

Method: The 21 German participants participated in a lexical decision task determining stimuli as "words" or "nonwords." They had an equal number of words in each condition being matched for letters, syllables, phonemes, frequency, and imageability.

Results/conclusion: The authors found that discrete emotions determined response time. Happiness related words were faster than neutral words. Disgust had the longest response time, above fear and anger. Discrete emotion conditions affected response time, even when arousal and valence was controlled.

Relevancy: This study contributes to the understanding of emotional recognition in words by categorizing emotional words rather than testing valence and arousal. It suggests that the emotion category, not the intensity, determines response time in participants.

Cicero, B. A, & Borod, J.C. (1996). Facial, prosodic, and lexical emotional perception in unilateral brain-damaged patients. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 61,* 6736.

Objective: This study assessed emotional perception across facial, prosodic, and lexical conditions. The author expected the findings would support the right hemisphere hypothesis across all conditions, which was correct.

Method: The 36 participants included right and left brain-damaged from a CVA and healthy controls. They participated in a variety of tasks including facial identification, facial discrimination, prosodic identification, prosodic discrimination, word identification, sentence identification, and word discrimination using positive, negative, and control stimuli.

Results/Conclusion: The study found that individuals with right brain-damaged were most impaired across all channels. Within the left-brain damaged group, they controlled for language difficulties. They found no significant differences across groups.

Method: This study suggests that individuals with language problems do not differ in their ability to identify emotion on non-speech tasks.

Cicero, B. A., Borod, J. C., Santschi, C., Erhan, H. M., Obler, L. K., Agosti, R. M., Welkowitz, J., & Grunwald, I. S. (1999). Emotional versus nonemotional lexical perception in patients with right and left brain damage. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology*, *12*, 255–264.

Objective: The study had two aims; to evaluate hemispheric participation in lexical emotion tasks with right brain-damaged patients, left brain-damaged patients, and control patients, and to evaluate if emotion content improves scores of left brain-damaged patients.

Method: The patients participated in the lexical perception tasks of the New York Emotion Battery. These tasks included a word identification task from a three-word cluster, a sentence task, each with positive and negative emotions. A third task was a discrimination task, requiring the participants to decide if paired words were same or different emotions. Control stimuli was created to match the emotion tasks.

Results/Conclusion: They found that right brain-damaged patients were impaired across all emotion tasks when compared to left-brain damaged and control patients. Left brain-damaged patients who had language deficits performed better on emotion tasks only during sentence identification, the most difficult task for participants. Overall accuracy was best on single word tasks for all groups.

Relevancy: These findings suggest that left-brain damaged patients are able to use emotion parts of their brain during more complicated lexical tasks, suggesting more stressful situations lead to increased linguistic processing and that facilitation occurs when linguistic processing is more demanding. It also suggests that individuals with language deficits are able to use emotion to improve accuracy more than general left brain-damaged patients. Right-hemisphere brain damaged patients did worse across all from the left-hemisphere brain damage and control group. Age and gender also may play a role.

Czimskey, N., & Marquardt, T. P. (2018). Recall of emotional and neutral words and paragraphs in traumatic brain injury. *Aphasiology, 8,* 1019-1034. doi: 10.1080/02687038.2018.1512079

Objective: This study aimed to determine if emotion affects recall of words and main ideas in paragraphs between individuals with a traumatic brain injury and healthy adults. Emotion increases recall due to more elaborate semantic encoding, enhanced retrieval cues, and greater consolidation of emotional stimuli.

Method: The participants listened to six lists of stimuli, each containing five neutral words, five emotional words, three neutral paragraphs, and three emotional paragraphs. The participants were then asked to recall the words, or retell the paragraph.

Results/Conclusion: This study found that healthy adults did better on emotion recall in words and paragraphs, but individuals with a traumatic brain injury only did better on emotion recall in words, not paragraphs.

Relevancy: This study gives background information regarding why and how emotion helps individuals with word recall.

Galletta, E. E., & Goral, M. (2018). Response time inconsistencies in object and action naming in anomic aphasia. *American Journal of Speech-Language Pathology*, *27*, 477–484. doi: 10.1044/2017_AJSLP-16-0168

Objective: The purpose of this study was to determine if people with anomic aphasia have practice effects in naming objects and action pictures through multiple trials.

Methods: Ten individuals with mild anomic aphasia and six healthy controls participated in the study. The participants were asked to name two sets of twenty-seven pictures ten times. The participants accuracy and response time was recorded.

Results/Conclusion: The anomic aphasia participants had slower, less accurate responses than the healthy controls. However, the anomic aphasia participants had response time inconsistencies. Healthy controls had a decrease in response time, followed by a plateau.

Relevancy: This study looks at response time in individuals with aphasia, demonstrating differences in response time speed based on the type of stimuli presented. Emotion stimuli was not analyzed, and the reaction time can be compared to these findings.

Hamberger, M. J., Seidel, W. T., (2003). 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. doi: 10.1017/s135561770393013x

Objective: The purpose of this study was to create correlating normative data for auditory and verbal naming measures that could be used clinically in assessing word retrieval. Often, word retrieval is assessed visually, when acoustic means are more functional.

Method: The study had fifty-six unilateral temporal lobe epilepsy (34 left, 22 right) who named objects in response to acoustic and visual stimuli.

Results/Conclusion: The individuals with left unilateral temporal lobe epilepsy performed worse on all word-retrieval tasks across groups, but individually did worse on auditory naming than visual naming.

Relevancy: This study provides information regarding the amount of time to allow when recording response time, as word retrieval was often manifest through delayed retrieval rather than failure.

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

Objective: This study was evaluating performance of patients with right cortical lesions vs. left cortical lesions on verbal (i.e., word categorization and inferencing) and nonverbal (i.e., prosody and facial expression) emotion perception tasks.

Method: Three different tests were performed: the first required participants to read an article, then reading time was recorded regarding a “critical sentence” describing the emotion of the protagonist. In the second test, the decision time of a lexical task was measured instead of the reading of a critical sentence. In the third tests, word fluency, emotion categorization, and emotion classification were measured.

Results/Conclusion: There were no major differences between participants with left and right hemisphere lesions. Both groups had deficits in inferring facial emotions, but the underlying cause was hypothesized to be different.

Relevancy: This study did not provide evidence to support any of the three hypothesis regarding emotion regulation in the brain, implying further evidence is needed to understand emotion processing.

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. doi: 10.4103/2277-9175.162540

Objective: The purpose of this study was to measure emotion and neutral word repetition in Persian language patients.

Method: The study had 100 monosyllabic words that they had 30 neurotypical adults rate the level of emotionality, producing 20 emotional and 20 neutral words. The 15 aphasic patients in this study were presented with a word and asked to repeat the word after 5 seconds. The response was scored as 1=correct or 0=incorrect, meaning in included a paraphasia.

Results/Conclusion: The study found no significant difference between neutral and emotional word repetition.

Relevancy: This study states the findings are different from previous findings, and different research methods may yield different results.

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. doi: 10.1016/j.cognition.2009.06.007

Objective: This study explores to theories of emotion impact on cognition; the withdrawal/averse and approach/appetitive.

Method: The authors determined confounding variables in association with research regarding the withdrawal/averse hypothesis and designed a study to account for these variables. A word/nonword list comprised of 40 positive, negative, and neutral words and 40 positive, negative, and neutral nonwords was created with similar lexical qualities. Participants viewed the stimuli and determined whether it was a word or nonword.

Results/Conclusion: The participants had faster latencies and greater accuracy when working with positive/negative words than neutral words.

Relevancy: This study demonstrated the importance of determining appropriate stimuli and supported the approach/appetitive hypothesis.

Landis, T., Graves, R., & Goodglass, H. (1982). Aphasia reading and writing: Possible evidence for right hemisphere participation. *Cortex, 18,* 105-112. doi: 10.1016/s0010-9452(82)80022-1

Objective: The purpose of this study was to measure reading and writing ability in individuals with unilateral cerebral brain damage.

Method: Three different lists of twelve words were classified as either “abstract” emotional, “concrete,” or “abstract” non-emotional. The 32 aphasic male subjects participated in two tests. During the first test, participants read given words from the prior mentioned categories. During the second test, the patients attempted to write the word. Responses were scored as correct, semantic substitution, or incorrect.

Results/Conclusion: The study authors found that reading scores correlated with placement of words in the normal left visual field. Results suggested word category was significant; emotion words were read the most accurately, followed by concrete words then non-emotion abstract.

Relevancy: As the aphasic patients participated in reading and writing, the emotion of the words contributed to how they performed, which may suggest the right hemisphere plays a part in emotion word processing.

Laures, J. S. (2005). Reaction time and accuracy in individuals with aphasia during auditory vigilance tasks. *Brain and Language, 95,* 353–357. doi: 10.1016/j.bandl.2005.01.011

Objective: Due to the lack of information regarding response time in individuals with aphasia, the purpose of this study was to measure response time and accuracy when individuals with aphasia perform a linguistic and nonlinguistic vigilance task.

Method: During the linguistic task, the participants listened to five words being randomly presented, pressing a button when the target word “myth” was presented. During the nonlinguistic task, the participants listened to four simple tones, pressed a button when a complex harmonic tone sounded.

Results/Conclusion: The individuals with aphasia had the same response time as controls when they got the item correct. However, individuals with aphasia were less accurate, had a high number of false alarms, and were more variable in their ability to respond within a 2500 ms time limit.

Relevancy: The results of this study were different than prior studies, demonstrating that the impacting variable was processing time and presentation of stimuli. These are variable that impact the response time of individuals with aphasia.

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. doi: 10.1016/S0911-6044(98)00008-6

Objective: The purpose of this literature review was to determine intact emotional abilities in individuals with left-hemisphere brain damage, and in what ways they differ from neurotypical adults.

Method: The author reviewed and reported on a myriad of published articles comparing emotion abilities in different damaged hemispheres and neurotypical adults.

Results/Conclusion: Individuals with left-hemisphere brain damage performed as well as control groups for both posed and spontaneous facial expressions and was impaired in individuals with right-hemisphere brain damage. Left-hemisphere brain damaged participants performed better than control and right brain damaged participants on a variety of tasks.

Relevancy: This study suggests individuals with left-hemisphere brain damage have many emotion capabilities that are spared, suggesting that they may have high response times on naming tasks.

Nilipour, R., Bakhtiar, M., Momenian, M., & Weekes, B. S. (2017). Object and action picture naming in brain-damaged Persian speakers with aphasia. *Aphasiology*, *31*, 388–405. doi: 10.1080/02687038.2016.1234583

Objective: This study aimed to determine if grammatical class made a difference in object and action picture naming tasks in Persian's with aphasia. They predicted that accuracy would be better for object naming than action naming.

Method: The participants in this study viewed pictures on a screen and were given 10s to name the item. The responses were scored as either "correct" or "incorrect."

Results/Conclusion: The study found that grammatical class did not make a difference on the correctness of the response, and that the participants performed better on object pictures than action pictures.

Relevancy: This study relates the aspects that did impact naming when controlled; these included imageability and age of acquisition. These two factors predict naming performance.

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

Objective: This study aimed to compare repetition of emotion/nonemotion words in people with aphasia, as well as compare the repetition between positive and negative emotion words.

Method: During this study, twenty aphasic males with a repetition disorder listened to a list of forty-four emotion/nonemotion words (i.e., twenty-two emotion and nonemotion words) and were asked to repeat them. Their first response was scored as either recognizable or unrecognizable.

Results/Conclusion: There was no significant difference between the average of the emotional word repetitions and the nonemotion words. There were more emotion word repetitions than abstract nonemotion words. After viewing the CT scans, the authors suggested that typical vs atypical cerebral asymmetry may correlate with repetition response.

Relevancy: This study suggests that individuals with aphasia are better at naming concrete items, while the positive and negative words were able to be repeated faster than abstract nonemotion words. This identifies areas were repetition may be easier or more difficult for people with aphasia.

Zgaljardic, D. J., Borod, J. C., Sliwinski, B. M. (2002). Emotional perception in unilateral stroke patients: Recovery, test stability, and interchannel relationships. *Applied Neuropsychology, 9,* 159-172. doi: 10.1207/S15324826AN0903_4

Objective: The purpose of this study was to use the New York Emotion Battery to look at emotion recognition recovery in patients with right and left brain-damage compared to a control group, as well as to measure the relationship between the three groups scores. *Method:* The twenty-three patients participated in the New York Emotion Battery tasks (i.e., facial perception, prosodic perception, and lexical perception) twice, a year in-between testings. The discrete emotions of happy, happiness, sadness, fear, anger, and disgust were measured across each subtest.

Results/Conclusion: This study suggested that both right and left brain-damaged participants were impaired in prosodic identification. They found that right-brain damaged did worse than the other two groups across the other subtests, but when gender was taken into account women tended to do better than men, consistent with other test findings.

Relevancy: This study gives information regarding the process of understanding emotion between different hemispheres of the brain on an array of emotion recognition tasks. It also identifies gender as a confounding variable.

APPENDIX B

Consent Form

Consent to be a Research Subject

Introduction

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.

Procedures

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.

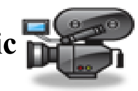
_____**YES** _____**NO** I give the study investigators permission to request copies of previous brain scans.

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

Stimuli

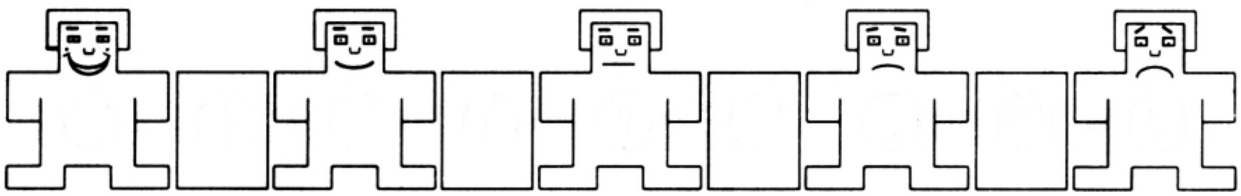
Neutral 1	Positive	Neutral 2	Negative	Neutral 3
cup	gold*	clarinet*	bomb	oar
elbow	wedding	pen	witch	box
chair	breakfast	rock	tornado	tie
newspaper	beach	foot	(hurricane)	cross
suit	dance	shirt	mosquito	nail
dustpan	candy	monk (friar,	hospital	forehead
hole	chocolate	priest)	rat	cube (box)
chalk*	star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

Note: * = items that were excluded; Parenthesis indicate acceptable alternative responses

APPENDIX D

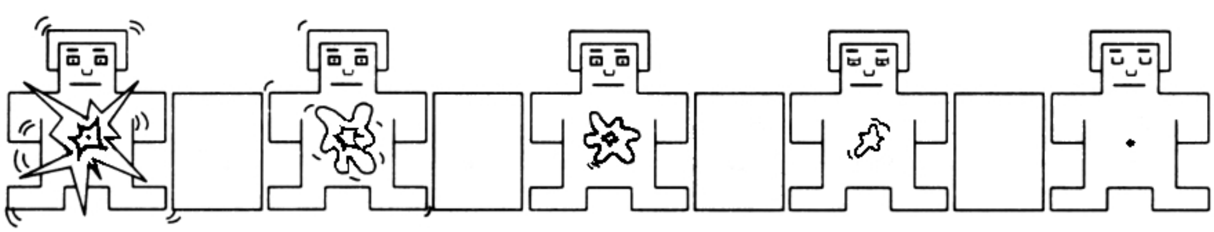
SAM Pleasure and Arousal

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.**



Happy **Unhappy**

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.**



Aroused **Unaroused**