

# EFFECTS OF MINDFULNESS MEDITATION ON THREE INDIVIDUALS WITH APHASIA

by

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## ABSTRACT

Recent research has suggested that individuals with aphasia perform with decreased accuracy on attention tasks compared to non-brain-damaged individuals. While there is still debate as to the nature and source of these attention deficits, research has shown that treatment for aphasia should incorporate remediation of attention in addition to language. Mindfulness meditation (MM) has successfully improved attention in non-brain-damaged individuals. Therefore, MM was employed in 3 individuals with aphasia utilizing a single-subject design over a 9 to 13 week period. The effects of relaxation on attention as well as sense of effort were also examined. Several implications regarding future research are discussed; however, no conclusive evidence on the effects of MM can be offered based on the results of this study at this time.

INDEX WORDS: Aphasia, Attention, Mindfulness Meditation, Sense of Effort, Relaxation

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## CHAPTER 1

### INTRODUCTION

The study of language as a neurological process traditionally commences with a discussion of the left hemisphere as the dominant center for language in the brain. Discussion continues with explanation of language comprehension centers versus language production centers, the processes of syntax, semantics, phonology, and so on. In addition, deficits in language following neurological insult (e.g., stroke) result in discussions of the well known disorder of aphasia. It follows that assessment and treatment for aphasia has typically centered on language. While attention deficits are more notably observed in individuals with right hemisphere brain damage, subtle but equally debilitating attention deficits can occur in individuals with left hemisphere brain damage. Recent research has determined that individuals with aphasia often present with deficits in divided attention (Murray, 1999). Though the cause is yet unknown, it is theorized in current literature that deficits in the overall capacity for attention and/or the ability to allocate and inhibit attention resources may contribute to the deficits observed (Murray, 1999; Shisler, 2005). When compared to the severe linguistic deficits in individuals with aphasia, these subtle attention deficits are often overlooked. This can be problematic given the fact that the recovery process requires multiple domains of cognition—including attention (Helm-Estabrooks, 2002; Ramsberger, 2005).

In addition, the literature has reported that individuals with aphasia may misjudge the amount of effort required to complete a demanding task. This inaccurate perception of task demand, or sense of effort (SOE), has been speculated as a possible source for decreased

performance on tasks which require divided attention (Clark & Robin, 1995; Murray, Holland, & Beeson, 1997a). Subsequently, SOE has been used as a means for evaluating attentional performance.

Currently, there are limited available treatments which specifically address attention deficits in individuals with aphasia (Helm-Estabrooks, 2002). Meditation has been indicated as a successful treatment for attention deficits in other health-related disorders for non-brain-damaged individuals. For example, research has shown that individuals with Attention Deficit Hyperactivity Disorder (ADHD) benefit from meditation when it is applied as a complementary treatment to medication (Arnold, 1999). In particular, the extensively researched meditative technique of Mindfulness has been found to elicit benefits for attention in typical individuals (Rutschman, 2004; Valentine & Sweet, 1999; Wenk-Sormaz, 2005). Mindfulness meditation (MM) may be a potentially promising treatment for individuals with aphasia. In addition, MM has been cited in many studies as having positive outcomes for individuals suffering from affective disorders such as depression and anxiety (Grossman, Niemann, Schmidt, & Walach, 2004; Kabat-Zinn et al., 1992; Miller, Fletcher, & Kabat-Zinn, 1995). This is relevant to individuals with aphasia, as research has shown that this population may suffer from depression, which can negatively affect the recovery process (Pachalska, Knapik, Smolak, & Pytel, 1987; Sarno, 1993). Because this type of meditation has been found to improve attention as well as affective disorders in non-brain-damaged individuals, it can be reasonably concluded that MM could be a possible complementary treatment for individuals with aphasia. The following study aimed to evaluate MM as a potential complementary treatment for divided attention deficits in individuals with aphasia and determine if there could be implications for prospective indirect improvements in language.

Divided attention was evaluated in 3 individuals with aphasia utilizing a dual, non-linguistic task similar to that of Erickson and colleagues' (1996) study. Performance on the task along with relaxation and SOE measures were evaluated as well. A multiple baseline single-subject design was used to show the effects of implementing MM as a treatment for deficits in divided attention. Data was collected over a 9 to 13 week period.

Results showed no changes in performance on the divided attention task, in language, or in relaxation as a result of the implementation of MM. In addition, measures of SOE revealed a relatively intact evaluation of task demand. All 3 participants exhibited high performance on the divided attention task with no obvious changes observed as a result of the implementation of MM. The above findings suggest several potential implications regarding attention and aphasia. First, the high performance on the divided attention task could indicate that not all individuals with aphasia have deficits in divided attention. Alternatively, the high performance observed may reveal that individuals with aphasia have varying degrees of attentional impairment which may only surface when certain demands are presented. However, the attention task chosen may have led to the high performance for these participants. A final possibility for the lack of change in attention could be due to the abstract nature of MM. That is, individuals with aphasia may require more direct and concrete forms of treatment to generate the benefits of attention that were seen in other populations. Furthermore, while procedural differences might explain the differing findings of the present study, it is important to consider other fundamental factors which may negatively impact attentional performance. Chief among these are individual differences of time post onset of injury, type of resulting aphasia, and severity of insult. Any or all of these factors have the likely potential to influence outcomes of treatment and of course, attentional performance.

Additional research is needed to determine the effects of MM on attention in individuals with aphasia. The lack of change observed in the present study could suggest that a more intensive treatment schedule may be needed for these individuals or that MM takes longer than 4 to 8 weeks to achieve gains in attention. While the present study found no changes in task performance as a result of practicing MM, several aspects of the findings warrant further observation. Future studies should continue to address the source and nature of attentional impairment in individuals with aphasia. In addition, exploring the interaction of language and attention is imperative in order to accurately and appropriately assess and treat individuals with aphasia.

## CHAPTER 2

### REVIEW OF THE LITERATURE

Aphasia can be defined as an acquired disorder that may disrupt the ability to comprehend, produce, and/or use language (LaPointe, 2005). For speech-language pathologists, the evaluation and treatment of aphasia have thus focused on language with traditional treatments involving a multitude of exercises to target the respective deficits. However, the deficits in aphasia go beyond language and can extend to executive processes such as memory and attention (Alexander, 2006; Nobre & Plunkett, 1997; Patel, Coshall, Rudd, & Wolfe, 2002). In fact, McNeil, Odell, and Tseng (1991) stated that the current view of the symptoms associated with aphasia can be explained in terms of a breakdown in multiple levels of cognitive functions. This implies that language does not exist in isolation, but rather, is intricately connected to such executive functions as attention. Alexander (2006) described language as the process of narrative discourse including operations of phonology, semantics, and grammar. However, he further explained that in order to accomplish the function of language—that is—communication, other functions of cognition are necessary. Tatemichi, Desmond, Stern, Paik, Sano, and Bagiella (1994) reported that the cognitive impairments (aside from language) which most commonly occur following a stroke were in the areas of memory, orientation, and attention.

One aspect of aphasia that has not been satisfactorily explained in terms of the linguistic deficits is the amount of variability in recovery and performance often seen in individuals with aphasia (Erickson, Goldinger, & LaPointe, 1996; Ramsberger, 2005). For example, speech-language pathologists often observe that the progress made by patients with aphasia and other

disorders of speech and language often fails to generalize to other environments or settings. Furthermore, their performance tends to lack consistency from one test to another (Tseng, McNeil, & Milenkovic, 1993). Erickson et al. (1996) suggested that this variability may be not the result of linguistic factors, but rather due to consequences from concomitant deficits in cognition. More specifically, Tseng et al. claimed that deficits in the cognitive process of attention may be the source for this variation. This contention is consistent with Alexander's (2006) claim that language is a holistic process involving multiple domains of executive function. Therefore, it follows that treatment for aphasia should incorporate treatment for these underlying deficits in attention (Helm-Estabrooks, 2002; Ramsberger, 2005).

Erickson and colleagues (1996) further explained that when the attentional system is presented with multiple stimuli, as with a divided attention task, performance on that task depends on three conditions. These include: (a) the amount of attentional resources available, (b) the specific demands of the task, and (c) the motivation of the participant. All of these factors are important to consider when determining a treatment plan for individuals with aphasia. That is, a decline in any of these three areas may impede the language recovery process in a natural environment where many distractions may impede communication.

### *The Attention Processing System*

The attention system in the non-brain-damaged individual is complex and involves a myriad of theoretical postulates which are important to consider. The theory of attention is based on two fundamental assumptions (Kahneman, 1973). The first assumption states that attention has a limited capacity available for cognitive processing. The second assumption states that these limited attentional resources are then allocated according to the demands present in the environment (McNeil et al., 1991). It is evident that when the attention system is damaged, the

cognitive resources available to an individual may be deficient. This deficiency may express itself in terms of a reduction in the overall capacity and/or in the allocation process (McNeil et al., 1991).

Posner and Petersen (1990) further defined attention according to its relationship with other cognitive processes. They first acknowledged that attention is separate from other cognitive functions (e.g., memory, executive function, etc.). They further explained that while the attention system is distinct, cognitive processing involves the interaction of multiple components. Additionally, Posner and Petersen contended that anatomically, attention is not a localized system but is distributed over the whole operating system of the brain and is responsible for multiple functions in the information processing system. Furthermore, McNeil et al. (1991) described attention as having two properties. The first property defines attention as a unit of limited resources, while the second property defines it as a system responsible for allocating these same resources across functional cognitive demands. A breakdown can occur at either of these levels where there may be a deficit in the mental capacity or a deficit in the allocation process (McNeil et al., 1991). In other words, a deficit in attentional capacity may result in fewer resources being available to support language. A deficit in allocation, however, may result in the failure of a healthy attention processing system to allocate its resources efficiently (McNeil et al., 1991).

The cognitive function of attention is a vital one on which language and memory rely (Alexander, 2006). For example, language processing requires an intact attention system in order to determine which information needs to be decoded as well as produced. Alexander (2006) described the production of language as setting an overall communication goal, sustaining linguistic processes to accomplish that goal, monitoring those processes, and inhibiting

unnecessary stimuli irrelevant to that goal. This interaction of cognition and language results in a complex information processing system. A breakdown in attention can thus cause deficits at many points in language processing—especially when language is required in less-than-ideal conditions, e.g., the everyday environment (Ramsberger, 2005). In addition, the available attention resources and the efficiency with which these resources are allocated vary between healthy individuals—especially when the aging brain is considered (Balota, Black, & Cheney, 1992; Hasher, Stoltzfus, Zacks, & Rypma, 1991). Therefore, it is important to decide when a true deficit exists in the attention system and when the system is within the scope of typical variation.

### *Attention and Aphasia*

*Inhibition and allocation.* Hasher and colleagues (1991) contended that typically aging individuals exhibit deficits in their ability to inhibit distracting information occurring in the environment resulting in a slight decline in attention and memory function. Therefore, it is important to distinguish when an individual is affected by an abnormal decline in attentional functioning versus the characteristic decline that often occurs with increasing age. In order to determine the extent to which attention declines during the healthy aging process, Wiener, Connor, and Obler (2004) compared the attention abilities of individuals with aphasia and non-brain-damaged aging individuals. These authors specifically looked at the ability of individuals with and without aphasia to inhibit unwanted information during a modified Stroop task.<sup>1</sup> Wiener and colleagues hypothesized that individuals with aphasia would have greater difficulty inhibiting the irrelevant information which, they predicted, would be evident in a slower reaction time (RT) during the Stroop task.

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<sup>1</sup> The Stroop task requires individuals to identify the color of a word presented, where the word itself is presented in a different color ink (e.g., the word *blue* would be presented in red ink). In this example, participants would be required to suppress the automatic response to read the word *blue* and to rather, say *red*, the color of the ink (Stroop, 1935).

The authors based their hypothesis on previous research which found that there appeared to be reduced inhibitory function in 5 individuals with Wernicke's aphasia (Milberg, Blumstein, Katz, Gershberg, & Brown, 1995). However, it was argued that this deficient inhibitory mechanism was due to age rather than damage to the brain (Balota et al., 1992; Earles, Connor, Frieske, Park, Smith, & Zwahr, 1997; Hasher & Zacks, 1988; Hasher et al., 1991). Therefore, Wiener et al. used age-matched individuals in both the control and experimental groups.

Results confirmed that RTs for the aphasia group were slower than the control group when inhibition was required during the task (Wiener et al., 2004). A significant difference was found between the groups when the tasks required individuals to suppress or inhibit information (e.g., saying the number "four" when they were visually processing "3333"). However, no significant difference was found when inhibition was not required (e.g., saying the number "four" when they were visually processing "4444"). This suggests that the slower RTs exhibited by the participants with aphasia were not due to aging, but to other cognitive deficits (Wiener et al., 2004).

By controlling for age, Wiener et al. (2004) established that the attention deficits often seen in individuals with aphasia are not solely due to aging, but are the result of a disordered attentional processing system. These deficits may be due to a reduced ability to allocate attention resources. Deficits in allocation and inhibition could indicate that individuals with aphasia may have increased difficulty processing information in their environment especially when multiple stimuli are present (e.g., talking with a family member while a television is on in the background). In such a situation, inhibition is required in order to focus on pertinent stimuli, and individuals with aphasia may show decreased performance with this.

*Lesion location and attention.* Murray, Holland, and Beeson (1997b) further evaluated attention deficits in individuals with aphasia by comparing the resource allocation skills in individuals with mild aphasia with the resource allocation skills of non-brain-damaged individuals. They questioned if lesion location impacted the degree of the deficit and whether or not the nature of the distraction impacted attention. Specifically, they examined two groups of individuals with aphasia. One group consisted of 8 individuals with frontal lobe damage and one group consisted of 8 individuals with posterior lobe damage. Their rationale for choosing these two lesion locations was based on previous research about resource allocation, which stated that the frontal lobe was responsible for dividing attention while the posterior lobe was responsible for representing and orienting incoming sensory information (Duncan, 1995; Mesulam, 1981; Posner & Petersen, 1990).

Murray et al. (1997b) examined the performance of these individuals on a lexical decision task under different conditions which varied the degree of attention that was needed. In order to vary the attentional demands, participants were required to complete the primary task in isolation as well as in conjunction with a secondary task involving auditory tone discrimination. The primary task consisted of a semantic judgment task in which the participants were required to determine whether the presented stimuli were part of a previously determined category (i.e., carrots—food), while the lexical decision task required the participants to identify whether a word was a real word or pseudo-word. The secondary task then consisted of identifying whether a tone was high or low in frequency. During the isolation condition, the participants were required to complete either the lexical decision or semantic judgment task, whereas in the focused attention condition a distracter tone was presented along with the primary tasks. However, during the focused condition, the participants were required to respond to only the

primary task, or the lexical decision task. Two divided attention tasks were used to determine if the nature of the attentional demands affected performance. During these tasks, both the primary (lexical) and secondary (tone) stimuli were simultaneously presented and responses were required for each stimulus. For example, the participants were instructed to determine if the presented word was part of the specified category first, and then determine if the tone presented was high or low in frequency (Murray et al., 1997b).

Results indicated that there was no significant difference in performance accuracy or RT between the groups during the isolation condition. This suggests that sustained attention may not be disordered in individuals with aphasia. However, both aphasia groups exhibited reduced performance compared to controls on the focused and divided attention conditions, suggesting that deficits may exist for these specific attention processes. Furthermore, no significant difference was found between the frontal and posterior lobe groups for performance on each condition (Murray et al., 1997b). The authors concluded that lesion location was not a determinant of attention deficits in these individuals with aphasia.

These results bring into question the source of deficits seen in the process of allocating attention resources in the brain. Consistent with McNeil and colleagues (1991), the authors suggested that there may be impairment in determining which stimuli require attentional priority (Murray et al., 1997b). In other words, individuals with aphasia may inaccurately estimate the amount of attention needed for a particular task. Another possible explanation for the observed deficits may be that individuals with aphasia have difficulties inhibiting secondary or irrelevant stimuli. In other words, they were not able to ignore the distracting stimuli and focus on the primary or relevant stimuli, i.e., the ability to inhibit, as was discussed earlier (Hasher et al., 1991; Murray et al., 1997b; Wiener et al., 2004). In addition, no significant differences were

found in the performance based on lesion location, and deficits in focused and divided attention were observed in both groups. It was suggested by the authors that a deficit within a common pathway between these two locations might be responsible for the attention deficits observed (Murray et al., 1997b).

The fact that attention deficits were observed in individuals with lesions in both locations indicates that attention resources might be drawn from a common source, or pool (Murray et al., 1997b). Therefore, when linguistic demands exceed attentional capacity, as in aphasia, the existing attentional resources become strained. The fact that all groups performed similarly during the isolation condition implies that attention deficits in individuals with aphasia are not due to reduced capacity, but result from an allocation deficit (Murray et al., 1997b).

*Effects of attention on language.* To further determine the extent to which attention deficits affect spoken language performance in individuals with aphasia, Murray, Holland, and Beeson (1998) used a similar procedure that assessed sustained, focused, and divided attention. Two groups of age-matched participants, including 8 control subjects with no history of brain damage and 14 individuals with aphasia, were required to complete a picture-description task in isolation and in conjunction with a tone-discrimination task. Each task was completed under three conditions. The first condition was to complete each task in isolation. In the focused attention condition, the participants were presented with both stimuli (the tone and the picture) but were required to respond to only one. The third condition required divided attention, in that the participants were required to respond to both stimuli simultaneously; however, they were told to give attentional priority to only one of the two stimuli (Murray et al., 1998).

The results indicated that the aphasia group performed less accurately than the control group on the lexical decision tasks during all conditions. In fact, deficits were seen in both the

quantity and quality of language in that as the complexity of the task increased, performance in the morphosyntactic, lexical, and pragmatic areas of language decreased. Consistent with previous studies, the performance of both groups was comparable during the isolation task. However, performance on the focused and divided attention tasks was reduced compared to the control group. The authors concluded that while linguistic deficits for individuals with aphasia are present even without attentional demands, divided attention deficits impact language (Murray et al., 1998).

Rather than assessing attention by manipulating conditions, Slansky and McNeil (1997) examined the effects that attention deficits might have on language in 12 individuals with aphasia by looking at the influence of word emphasis on attention. The study further addressed how individuals with aphasia would compare to 12 non-brain-damaged participants when using their processing resources to complete the tasks at hand (Slansky & McNeil, 1997). During the experimental condition, each participant was told that he/she would hear a phrase containing two primary target words: “We saw the *T1* and the *T2* today” (Slansky & McNeil, 1997, p. 463). The participants were required to determine if *T1* was a member of a specified category as well as determine if *T2* was a real word. Accuracy as well as response times were obtained for both *T1* and *T2*. Emphatic stress was placed on *T1* half of the time while the second word, *T2*, was always the unstressed word. Assuming that the stressed words would require more attention, the authors proposed that auditory comprehension would increase for the stressed information and decrease for the non-stressed information.

The results revealed an increase in the response times for the *T2* stimuli in the non-brain-damaged participants, which was predicted by the authors (Slansky & McNeil, 1997). This is consistent with the limited capacity resource allocation theory, which states that if one devotes

more attention to a particular stimulus during a dual-task trial, then the secondary stimulus may suffer in accuracy and response times (Kahneman & Treisman, 1984; Navon & Gopher, 1979). This is indeed what the authors found in the control group. However, the participants with aphasia differed from the controls in that they failed to allocate resources to the stressed word but rather, evenly dispersed their attention between both stimuli. Therefore, no significant response time or accuracy differences were found between T1 and T2. These results indicated that the allocation of attention resources is dependent on the perceived task complexity and that if these demands require the majority of available resources, any processing that requires attention thereafter will suffer. Slansky and McNeil argued that the slower response time and decreased accuracy could be attributed to inefficiency in the allocation process. They further contended that deficient responses could also be explained by an overall reduced capacity for attention. Therefore, the inefficiency in the allocation of available resources could explain the pronounced deficits in the performance of individuals with aphasia during conditions that require divided attention (Slansky & McNeil, 1997).

Murray (2000) supplemented the previous studies of language and attention when she examined the word retrieval abilities of individuals with aphasia during varying attentional tasks. Murray compared the performance on a phrase completion task between 14 individuals with aphasia, 8 individuals with right hemisphere brain damage (RBD), and 9 non-brain-damaged individuals. Again, participants were instructed to complete a phrase in isolation, with a distraction (tone presentation), and in conjunction with a secondary task of discriminating between two tones. Accuracy and RT were recorded during each task. Results indicated that the groups' word retrieval abilities were similar during the isolation condition. However, performances of the aphasic and RBD groups were significantly poorer than the non-brain-

damaged group during the focused and divided attention conditions (Murray, 2000). These results were consistent with previous studies concluding that not only did individuals with aphasia suffer from deficits in attention, but those deficits increased in severity as task complexity increased; similar to findings on divided attention tasks.

It must be noted that this study, as well as the previously discussed studies, examined attention using linguistic tasks. As such, the question still remains as to the extent that language deficits in aphasia are due to failures in attention or to linguistic processes, or alternatively, as a result of deficits in both. If the language deficits observed in individuals with aphasia are due to linguistic deficits alone, then in theory, performance on non-linguistic tasks assessing attention should not differ from the performance of non-brain-damaged individuals. However, if language deficits are due to decreased capacities in both attention and language, then performance should decline in non-linguistic attention tasks as well.

Regarding the question of the source of linguistic deficits in aphasia, McNeil and colleagues (1991) stated that most current theories of language processing suggest an interaction of many cognitive operations in the brain. Therefore, they contended that deficits in language could be explained as a failure of one or more of these cognitive processes (McNeil et al., 1991). McNeil et al. further claimed that attention deficits are the cause for linguistic deficits in individuals with aphasia and that the rules for linguistic units (i.e., syntax, semantics, etc.) are not lost with aphasia but preserved. For example, Friederici and Kilborn (1989) hypothesized that the asyntactic comprehension deficits observed in individuals with Broca's aphasia might be due to impairments in the attention allocation system rather than to deficits in the linguistic knowledge of syntax. McNeil et al. explained that in individuals with aphasia, these linguistic processes rely on a depleted pool of attention resources, which results in a reduction in their

ability to access linguistic knowledge of syntax and other language processes. As a result, according to these authors, more than just language is depleted in aphasia, and the goal for aphasia treatment should not only include improving language, but should include treatment for attention as well (Helm-Estabrooks, 2002; McNeil et al., 1991).

*Linguistic influence on attention performance.* Considering that language and cognitive processes are intricately linked, the tasks used to assess attention must be carefully considered, especially in individuals with aphasia. In other words, using linguistic tasks to assess attention may lead to an inability to distinguish between linguistic and attentional deficits (Erickson et al., 1996). Erickson and colleagues (1996) evaluated the attention mechanism using non-linguistic tasks in order to distinguish between deficits in language processing and the attentional processing system. A previous study conducted by LaPointe and Erickson (1991) found decreased performance in individuals with aphasia during a divided attention task that used linguistic stimuli in order to test auditory vigilance (i.e., identifying a target word while sustaining attention to auditory stimuli). Erickson and colleagues (1996) called attention to the fact that studies using linguistic stimuli to evaluate attention resulted in an inability to distinguish true attention deficits from deficits in language. Therefore, non-linguistic stimuli were used to measure auditory vigilance.

Twenty persons participated, including 10 individuals with Broca's aphasia and 10 non-brain-damaged controls. All individuals with aphasia were similar in age and months post-onset. The task consisted of sustaining auditory attention to non-speech stimuli during two conditions (Erickson et al., 1996). In one condition, the participants were required to raise their unaffected hand when they heard the target stimuli (a specified tone frequency) among randomly presented stimuli. The second condition consisted of the same task as above with the additional task of card

sorting. There was no statistically significant difference in the performances of the groups on the single task, but there was a significant difference on the dual-task condition (Erickson et al., 1996). The aphasia group performed with decreased accuracy when compared to controls during the divided attention condition. This is consistent with previous findings in the literature, which suggested that individuals with aphasia present with deficits specifically in divided attention as opposed to sustained or focused attention (Murray et al., 1997a, 1997b; Murray, 1998, 2000). In addition, the authors stated that the decrease in accuracy observed in the aphasia group may be due to an inability to evaluate what the focus of attention should be. That is, these individuals may have difficulty in allocating attention resources secondary to decreased evaluation of task demands (Erickson et al., 1996).

Having established that attention declines when task complexity increases, Peach, Rubin, and Newhoff (1994) sought to determine when the breakdown occurs. They accomplished this by using brain imaging techniques to examine the preconscious processing of attention. Electrophysiological testing was used to obtain the measurements needed to analyze the role of attention in the subconscious brain (Peach et al., 1994). This procedure elicited mis-matched negativities (MMN) in event-related potentials which can be seen on wave-forms (Peach et al., 1994). These MMN's represent the difference between conscious and subconscious attention and as a result, are said to be capable of identifying preconscious attention to auditory stimuli, which are not the primary focus of attention (Peach et al., 1994). In order to obtain these measures, Peach and colleagues presented 7 participants (5 with aphasia and 2 without) with competing auditory stimuli, and instructed each participant to focus on one stimulus while ignoring the other. The amount of attention that was given to the ignored stimuli was assumed to be the amount of subconscious attention that co-occurred with the conscious effort of attending to the

other stimuli (Peach et al., 1994). The results indicated that the participants with aphasia required more time to allocate attention once they detected the two different auditory stimuli. According to the authors, the fact that the individuals with aphasia processed information at the preconscious level and at a slower rate implied that there were both capacity and allocation deficits (Peach et al., 1994).

Peach and colleagues (1994) reported that their findings did not support a previously held theory, which stated that attentional deficits observed were due to impairments in arousal, i.e., the slower RTs exhibited by individuals with aphasia were hypothesized to be a result of attention arousal (McNeil et al., 1991). Rather, these authors found that the participants' response time to the different auditory stimuli were well within normal limits even at the preconscious level. The authors contended that the attention deficits observed in individuals with aphasia were due to inefficient allocation of resources subsequent to the perception of stimuli (Peach et al., 1994).

Attention deficits were also found in a visual dual-task study by Marshall, Grinnell, Heisel, Newall, and Hunt (1997). Thirty-six individuals with history of left-hemisphere stroke and a control group of 20 individuals participated in a study which required keeping a moving target (blue cross) centered on a computer screen. The task was completed in isolation as a measure of sustained attention. In the divided attention task, the participants were required to press a button on the computer mouse when designated visual targets were detected while simultaneously centering the cross on the screen. Consistent with previous studies of attention (Erickson et al., 1996; Murray et al., 1997a, 1997b, 1998), Marshall and colleagues found that the individuals with aphasia performed similarly to the control group during the task of sustained attention but inferior to the control group when task complexity increased, requiring divided

attention. These results further supported the conclusion that individuals with aphasia demonstrate deficits on divided attention tasks, specifically when required to rapidly shift attention between two stimuli competing for attention (Marshall et al., 1997).

In summary, by varying conditions in attention studies comparing individuals with aphasia to non-brain-damaged individuals, research has found that individuals with aphasia exhibit deficits in tasks requiring divided attention (Erickson et al., 1996; Marshall et al., 1997; Murray, 2000; Murray et al., 1997a, 1997b, 1998). While the cause for these deficits is debated, there is a general consensus that individuals with aphasia may exhibit a depleted pool of attention resources and/or may additionally present with a decreased ability to allocate those limited resources. The question still remains if fewer attentional resources cause the linguistic deficits observed in aphasia or if existing linguistic deficits are exacerbated by a depleted attention capacity. One way to assess this is with the use of non-linguistic attention tasks for individuals with aphasia. However, some researchers have contended that an additional process may be responsible for the poorer performance exhibited by individuals with aphasia on attention tasks. Certain studies (Clark & Robin, 1995; Murray et al., 1997a; Tseng et al., 1993) suggest that the reason for the deficits observed in allocation are secondary to decreased ability to accurately evaluate task demand, or sense of effort (SOE).

#### *Sense of Effort and Attention*

The use of increasing attentional task demands is a common method used by researchers to demonstrate divided attention deficits in individuals with aphasia; however, according to some authors, increasing task demands may not be perceived as more difficult to individuals with aphasia. It has been suggested that decreased abilities in divided attention tasks for individuals with aphasia may be due to deficits in the evaluation of task demands.

Clark and Robin (1995) explored deficient evaluation of task demands as a possible explanation for the reduced performance that is often observed in divided attention tasks in individuals with brain injury. The authors contended that an inability to accurately assess task demands leads to a decreased SOE during tasks requiring divided attention. The authors defined SOE as one's perception of how much mental or physical effort was expended during a task as measured by a rating scale labeled 0 to 200. Clark and Robin claimed that SOE reflects, and may influence, the amount of cognitive resources expended during a task. They hypothesized that individuals with brain damage would expend more effort during a task given that they have a depleted amount of attention resources when compared to controls (Clark & Robin, 1995).

A lexical decision task was utilized in order to determine if SOE was a true indicator of available resources in both non-brain-damaged individuals and in individuals with traumatic brain injury (TBI) and left cerebrovascular accident (CVA). The participants completed a reading task in which they were required to distinguish between real words (either concrete or abstract) and pseudo-words (Clark & Robin, 1995). Research has established that pseudo-words require greater cognitive effort to process (Xu et al., 2001). Therefore, the authors hypothesized that RT would increase for the words requiring greater cognitive effort. However, the SOE reported by the individuals with brain damage did not confirm this hypothesis. In fact, the individuals with brain damage did not report an increase in perceived effort. Results showed that despite a decrease in task performance relative to the controls (i.e., increased RT) individuals with brain damage did not report an increase in SOE ratings (Clark & Robin, 1995).

Clark and Robin (1995) discussed two possible reasons for the findings in opposition to their original hypotheses. One possibility contended that individuals with brain damage may not have perceived a difference in word complexity due to an inaccurate perception or evaluation of

task demand. As a result, these individuals neglected to appropriately allocate their attention resources. The other explanation presented was that an inaccurate SOE may have caused the individual to misjudge the amount of attention resources needed for the task. In other words, an individual with brain damage may fail to expend the appropriate amount of resources secondary to an inaccurate perception of task difficulty (Clark & Robin, 1995).

Murray and colleagues (1997a) aimed to determine if SOE deficits existed in individuals with aphasia; however, their goal differed slightly in that they considered whether monitoring one's own accuracy during tasks or evaluating task demands was the source of attentional deficits. Murray et al. presented a lexical decision task under three conditions which taxed varying degrees of attention. The three conditions consisted of: (a) performing the lexical decision task in isolation, (b) performing the task along with either a verbal or nonverbal distracter task but still only completing the lexical task (i.e., focused attention condition), and (c) performing both the lexical and auditory tasks simultaneously (i.e., divided attention condition). A group of individuals with aphasia as well as a non-brain-damaged control group were required to rate their task accuracy as well as their perceived SOE (Murray et al., 1997a). Results indicated that the individuals with aphasia were able to accurately monitor their task performance during the various conditions. However, consistent with the findings of Clark and Robin (1995), Murray et al. (1997a) found that the individuals with aphasia exhibited similar SOE ratings as the control group despite their poorer performance. These authors speculated that the poorer performance exhibited by the individuals with aphasia may be explained, in part, by an inaccurate evaluation of task demands.

Tseng and colleagues (1993) conducted a study to investigate attention allocation deficits commonly associated with auditory processing in aphasia. Again, they found deficits in the task

evaluation mechanism in individuals with aphasia. The study consisted of 9 individuals with aphasia and 18 non-brain-damaged controls. The researchers presented both groups with identical tasks which required divided attention, in which the participants were required to detect phonetic as well as semantic targets. There were four conditions in which the tasks were completed. In the first two conditions, participants were told to listen for certain target stimuli as well as when the stimuli would occur. No cues were provided during the other two conditions. These conditions were designed to evaluate whether providing verbal cues and alerts (i.e., attentional focus) would increase performance accuracy and RT. The authors argued that their method drew from the optimum model theory, which states that the attention system accomplishes efficiency by allocating its resources according to the demands of the tasks. In theory, the more one is prepared for assessing the demands of attention, the more his/her performance accuracy should increase (Tseng et al., 1993). Results indicated that the control group responded faster and more accurately than the aphasia group when cues were provided preceding the task. In contrast, the aphasia group's performance did not improve when cues were given. These findings were consistent with previous conclusions (Clark & Robin, 1995; Murray et al., 1997a), which suggested that individuals with aphasia fail to evaluate task demands properly and are therefore not expending an appropriate amount of attention for the required task (Tseng et al., 1993).

Based on previous research, it could be argued that individuals with aphasia exhibit deficits in attention, particularly when a rapid shift between stimuli is required and when inhibition of unwanted stimuli is necessary, as is the case in divided attention tasks (Erickson et al., 1996; Marshall et al., 1997; Murray, 2000; Murray et al., 1997a, 1997b, 1998). Though the source of attention deficits observed in individuals with aphasia is still debated, a review of the

research supports the following theoretical contentions: (a) a possible overall decrease in attention capacity, (b) a deficit in the allocation of attention resources, and (c) a deficit in evaluating the cognitive demands of a task (Erickson et al., 1996; Murray et al., 1997b; Murray et al., 1998; Peach et al., 1994; Slansky & McNeil, 1997; Wiener et al., 2004). Treatments that specifically target these deficits may be beneficial for individuals with aphasia. However, there are currently only a limited number of available treatments which target attention processes. Rather, current treatments for aphasia mainly focus on linguistic deficits (Helm-Estabrooks, 2002). While these treatments work for some individuals, they have proven ineffective for others and are inconsistent from one individual to the next (Erickson et al., 1996). If deficits in attention contribute to the linguistic deficits observed in aphasia, directly targeting attention in therapy may be needed to maximize recovery.

#### *Mindfulness Meditation and Attention*

Several non-linguistic-based treatments for attention have been discussed in research involving pharmacology and lifestyle changes such as diet and exercise (Chan, 2002; Tantillo, Kesick, Hynd, & Dishman, 2002). Another potential treatment for attention to be discussed in this study is the practice of MM. In addition to diet and exercise, speech-language pathologists could recommend and employ MM to/with their patients as a potential complementary treatment to traditional language therapy. It has been well established that the practice of meditation offers many health and psychological benefits (Davidson, Goleman, & Schwartz, 1976; Davidson et al., 2003; Grossman et al., 2004; Kabat-Zinn, 1982; Kabat-Zinn et al., 1992). Specifically, the practice of MM has been studied extensively in the fields of medicine and psychology. MM, rooted in the traditions of Buddhism, has only recently entered mainstream Western culture. Today, the practice of MM has been adapted as means of reducing stress and treating behavioral

and psychological disorders (Kabat-Zinn, 2005). It can be described as a receptive meditative practice in which the goal is to focus attention on multiple stimuli, which may be external (e.g., environmental) or internal (e.g., thought), while simultaneously maintaining a neutral, moment-to-moment awareness of those stimuli (Bishop et al., 2004; Dunn, Hartigan, & Mikulas, 1999; Kabat-Zinn et al., 1992; Valentine & Sweet, 1999). Kabat-Zinn (2005) described MM as “paying attention in a particular way: on purpose, in the present moment, and non-judgmentally” (p. 4). Gunaratana (2002) further described MM as learning to “watch changes occurring in all physical experiences, feelings, and perceptions, and learn[ing] to study his or her own mental activities and the fluctuations in the character of consciousness (p. 4).” Variations of MM are frequently employed as a complementary treatment to traditional remediation for chronic conditions such as anxiety, stress, fibromyalgia, and cardiovascular disease (Grossman et al., 2004; Kabat-Zinn, 1982, Kabat-Zinn et al., 1992). Recently, meditation has also been found to increase cognitive processes including those of attention and awareness (Rutschman, 2004; Valentine & Sweet, 1999; Wenk-Sormaz, 2005).

MM can be seen as distinct from other forms of meditations such as concentrative meditation. In fact, MM and concentrative meditative techniques tap different attentional processes and involve very different practices (Dunn et al., 1999; Valentine & Sweet, 1999). For example concentrative meditation focuses attention on a single objective, specifically targeting sustained attention, or vigilance. In contrast, MM trains the individual to maintain an overall neutral awareness of his/her surroundings, specifically targeting divided attention (Bishop et al., 2004; Dunn et al., 1999; Kabat-Zinn, 1982; Valentine & Sweet, 1999).

Neuroimaging and brain activation studies have found that different types of meditation result in distinct physiological changes in the brain, providing further evidence that MM and

concentrative meditations are unique and separate (Banquet, 1973; Cahn & Polich, 2006; Kutz, Joan, Borysenko, & Benson, 1985; Lazar, Bush, Gollub, Fricchoine, Khalsa, & Benson, 2000). Lutz, Greischar, Rawlings, Ricard, and Davidson (2004) compared brain wave activity in long-time Buddhist meditators with the brain waves of non-meditators. The Buddhist meditators practiced a form of MM the authors described as “objectless” meditation in which there was no particular focus or main point to meditate on (Lutz et al., 2004). The control group consisted of individuals who had no previous experience with meditation, and were trained for one week on a modified form of MM. The control group was instructed to practice for one hour each day. An initial baseline electroencephalogram (EEG) was taken on both groups in which participants were instructed to remain in a relaxed, and non-meditative state. Each group was then instructed to meditate for 20 seconds while brain activity was recorded. EEG recordings indicated that there were differences in brain activity between the Buddhists and the non-meditators when at rest, suggesting that extensive practice of meditation may alter brain wave activity permanently (Lutz et al., 2004). This study provided neurological evidence supporting the behavioral changes and benefits often seen in individuals who meditate. It must be noted however, that other lifestyle variables (e.g., age, diet, etc.) in addition to the practice of meditation could explain the differences observed in brain activity and must therefore be considered as possible confounds to these findings.

Dunn and colleagues (1999) provided further evidence of neurological changes following meditation; they also sought to determine the effects, if any, of short term meditation on the brain. Dunn et al. achieved this by recording the EEG patterns of 10 college students before and after concentrative and MM training. These authors purported that MM must begin with training concentrative techniques because the individual must be able to silence the mind before

beginning MM. Therefore, each student completed five weeks of training with the first half consisting of concentrative meditation and the second of MM. Following the completion of training, EEGs were completed on each student while he/she meditated for a total of 15 minutes. During the EEG recordings, the students were instructed to remain relaxed with eyes closed, but to practice no formal meditation. They were then told to practice concentrative meditation for the next three to five minutes, and to move onto MM for the remaining duration of the EEG (Dunn et al., 1999).

Results indicated different EEG patterns for each condition, i.e., rest, concentrative, and MM (Dunn et al., 1999). MM produced greater amounts of delta and theta waves than concentrative meditation, indicating a calm and relaxed state. Additionally, MM resulted in a greater amount of alpha and beta 1 waves indicating the occurrence of active mental cognitive processing. In an attempt to confirm that each student was practicing the correct form of meditation, the experimenters asked each student to rate how well he/she practiced the assigned meditation on a scale from 1 to 10. The student's subjective ratings correlated with wave patterns seen on the EEG for both concentrative and mindfulness meditators. The authors concluded that the unique EEG patterns of brain activation observed during the three different conditions established that each meditative technique results in a unique form of consciousness (Dunn et al., 1999). In other words, concentrative and MM techniques produce different patterns of brain activation and therefore, should be identified as unique forms of meditation focusing on different processes.

Dunn et al.'s study provided further evidence that even a short period of meditation training may lead to neurological changes. In addition, the authors stated that the EEG findings proved that both forms of meditation produce effects on the brain that are distinct from

relaxation effects alone. This finding supported the contention that the benefits of both concentrative and MM are not exclusively due to the individual's experience of a relaxed state, but are due, at least in part, to the neurophysiological changes that they produce (Dunn et al., 1999).

Given that meditation alters brain activation, researchers further sought to determine exactly what effects these physiological changes have on the behavior of individuals. Valentine and Sweet (1999) aimed to explore the effects that mindfulness and concentrative meditation would have on a sustained attention task in non-brain-damaged individuals. In addition, they sought to determine if expectancy effects affected performance on tasks of attention. The authors hypothesized that since each form of meditation activated different regions of the brain (Kasamatsu & Hirai, 1966; Pribram, 1971; Pimbram & McGuinness, 1975), each type would have a different effect on attention. Valentine and Sweet (1999) compared the performance of 19 meditators (including both concentrative and mindfulness techniques) and 24 controls on the Wilkens' Counting task. This task employed sustained attention by requiring the individual to count auditory beeps introduced at random intervals while keeping track of the number of beeps heard. At the end of each session, individuals reported the number of beeps. Each group performed the task in three different sets where the first two sets consisted of beeps presented at a slower rate than the final (third) set. In addition, the concentrative meditators were told to make the focus of their meditation the auditory stimuli, and the mindfulness meditators were told to practice their usual technique.

The results indicated that both groups of meditators performed more accurately than the controls on the sustained attention task for sets one and two, indicating that meditation may have improved attention (Valentine & Sweet, 1999). Additionally, there were no differences observed

between the performances on sets one and two between the two types of meditators. However, the MM meditators performed more accurately than the concentrative meditators on the third, unexpectedly fast presentation of beeps. Valentine and Sweet deduced that the MM meditators performed more accurately than the concentrative meditators during the unexpectedly faster third set, because MM requires a constant shifting of attention (Bishop et al., 2004), as opposed to focusing attention on a single stimulus (i.e., concentrative meditation). This contention is consistent with reported findings that mindfulness and concentrative meditations result in differing brain wave patterns (Dunn et al., 1999). The findings presented by Valentine and Sweet established that meditation generally improves attention, and MM in particular, may specifically improve divided attention.

Levy, Jennings, and Langer (2001) borrowed aspects of MM practices and applied them to a functional recall task in order to assess attention in older individuals. These experimenters compared the performance of four groups of 80 individuals ranging in age from 60 to 89 on a recall task. The individuals were required to view a series of colored pictures and then recall the content of those pictures. The authors attempted to vary the conditions of the tasks by altering the instructions given to each group on how they were to view the picture. One group was told to look for three distinctions in the pictures, a second group was told to look for five distinctions, the third group was merely told to pay attention, and the fourth was given no other instruction than to turn the page. The authors determined that the instructions requiring the individuals to look for distinctions were mindfully based because they were asking the individuals to focus attention not on one thing but on many, thereby rapidly shifting attention across stimuli. In addition, Levy and colleagues found that the individuals who were given the mindful directions recalled more pictures than the other groups.

The authors contended that paying attention to distinctions and shifting attention between stimuli not only increased participants' ability to recall images, but also helped to focus attention. In fact, MM requires a continuous shift in the focus of one's attention between stimuli (Bishop et al., 2004). Though Levy and his colleagues did not employ the physical practice of meditation, it is evident that applying similar attention techniques to identifying distinctions in pictures may have positive effects on memory and recall. Individuals with attention deficits may therefore benefit from training to shift attention, similar to the skill utilized during MM (Bishop et al., 2004; Levy et al., 2001).

If MM improves attention, what aspects of the meditation lead to those improvements in attention? In other words, are the cognitive techniques utilized in MM responsible for improving the core processes of attention, or are the secondary effects of meditation, such as relaxation, responsible for the improvements seen in attention? Rutschman (2004) sought to answer this question by comparing the performance of two groups on a divided attention task. Rutschman divided 35 college undergraduates into two groups based on the level of experience they had with MM (determined by a questionnaire). The students who reported that they practiced MM were placed into the meditation group while the students who reported that they had no experience with any meditation were placed into a relaxation control group. The task required the participants to follow a visual rotary pursuit (primary task) while simultaneously deactivating a buzzer (secondary task). The assigned meditative state (i.e., MM or relaxation) was then performed both prior to and following the task of divided attention (Rutschman, 2004).

Performances of the two groups indicated that both meditation and relaxation improved attention capacity (Rutschman, 2004). However, the meditators' performance increased significantly in comparison to the non-meditators. Consistent with the findings of Dunn and

colleagues (1999), Rutschman contended that the improved performance was not solely due to the effects of relaxation, but to the attention processes occurring during the meditation. However, it must be noted that a possible confound to this particular study is evident in the inability to completely separate the act of meditation and the effects of relaxation. Therefore, the influence of relaxation on the effects of meditation cannot be ruled out as a confounding variable in this study. Rutschman further found that MM improves the ability to rapidly shift attention between two tasks, as well as increase readiness. This is consistent with previous findings that MM specifically improves the process of attention which is required during a divided attention task—that is, the type that is required to shift attention, as well as maintain vigilance (Bishop et al., 2004; Davidson et al., 1976; Levy et al., 2001; Valentine & Sweet, 1999; Wenk-Sormaz, 2005).

The abilities of maintaining vigilance and rapidly shifting attention between stimuli are needed during tasks that require suppression of automatic, or habitual, responses, such as the Stroop task. Wenk-Sormaz (2005) was interested in whether meditation might decrease habitual responses that are often seen in tasks which tax automatic responses. This author specifically looked at Zen meditation, a form of meditation similar to MM. Participants were assigned to three groups consisting of a meditation group, a learning group (given strategies to complete tasks), and a rest group (instructed to sit for 20 minutes). Each participant was then randomly assigned to one of two tasks. One condition required completion of a category production and word-stem completion task, while the other condition required completion of the Stroop task. Wenk-Sormaz hypothesized that meditation would decrease the tendency of the individual to habitually, or automatically, respond during the Stroop task given that meditation is intended to increase overall awareness and readiness. That is, the meditator would be less likely to read the written word and more likely to report the color of the word (i.e., the object of the Stroop task).

Participants attended three sessions during the study, two of which were training sessions for the assigned condition (Wenk-Sormaz, 2005). During the third session, each participant practiced his/her assigned condition and then completed one of the two tasks. Measurements on the two tasks were taken immediately before and after the individuals practiced their specified condition. Results indicated that the meditation group exhibited fewer habitual responses on the Stroop task but not on the word production task. Habitual responses on the word production task were defined as typical, where non-habitual responses were defined as atypical. The author suggested that the reason for the differences seen on the performance of these two tasks relied on the fact that MM specifically improved selective attention—a type of attention related and involved in divided attention. Selective attention is needed in order to inhibit distracting, or unwanted, information. For example, in the Stroop task, selective attention is utilized when the individual must suppress the automatic tendency to read the written word and rather, express the color of the ink (Deikman, 1963; Wenk-Sormaz, 2005). The author further contended that the habitual responses observed during the word-production task might be a product of the participants' belief that habitual responses rather than non-habitual responses were more correct.

In order to determine if this was the case, a second study was completed in which the participants were told that atypical responses were preferred over typical responses. When the revised instructions were provided to both groups, results found that the meditators continued to produce more atypical responses, consistent with the findings from the Stroop task (Wenk-Sormaz, 2005). Wenk-Sormaz's findings support the previous notion that meditation may improve attention. She also demonstrated that even brief training and practice (20 minutes) may improve performance on attention tasks.

McMillan, Robertson, Brock, and Chorlton (2002) would argue with Wenk-Sormaz (2005) that brief meditation results in improvements in attention, as they found that brief MM training did not improve attention in brain-damaged individuals. McMillan and colleagues trained 145 individuals with varying severities of TBI on a type of MM termed attentional control training (ACT) in order to determine if this training would improve scores on various attention questionnaires. Questionnaires purported to measure attention were administered to the participants both prior to and after brief training in ACT. The participants were divided into a meditation group, physical exercise group, and a control group that received no training. The meditation group received supervised training for five 45 minute sessions over a four week period. They were also given a tape and instructed to practice the meditation daily at home. The physical exercise group received the same amount of training, except training was based on physical fitness rather than meditation. The control group received no special training but was evaluated at the same time intervals as the experimental groups.

No statistically significant differences were found between and within groups pre- and post-training (McMillan et al., 2002). Based on these results, McMillan argued that brief training in meditation has no benefit to attention. However, results of this study must be interpreted with caution as questionnaires, rather than direct assessments of attention were used. This would limit the interpretation regarding the direct effects on attention. Other factors that warrant further caution include the fact that TBIs often result in an expansive presentation of symptoms inviting other deficits that may affect an individual's receptiveness to meditation training. Furthermore, the authors did not provide a thorough description of the different types of training, prohibiting future replication.

To examine the issue of varying experience levels with meditation, Jha, Krompinger, and Baime (2007) aimed to explore the effects of Mindfulness Based Stress Reduction (MBSR) on attention in three groups with varying degrees of experiences with meditative practice. MBSR is a stress reduction program designed to train individuals to use MM as a way to reduce stress in everyday life, as well as to cope with chronic anxiety and other health issues (Davidson et al., 2003; Kabat-Zinn et al., 1992; Kutz et al., 1985; Miller et al., 1995). These authors divided attention into three types consisting of alerting, orienting, and conflict monitoring. Participants with no previous meditation experience attended an MBSR group over the course of 8 weeks. The second group consisted of participants with previous experience in concentrative meditation. These individuals participated in a 1-month retreat where they intensely practiced MM. The third group, or the control group, had no previous experience with MM and did not practice or participate in any form of meditation during the study (Jha et al., 2007). Attention was measured pre- and post training for all three groups and consisted of determining the direction of an arrow on a computer task for 25 minutes. Data was collected on RT and accuracy for all three types of attention.

Results for initial testing revealed no significant difference between the RT and accuracy for alerting and orienting types of attention between the control group and experimental groups (Jha et al., 2007). However, there was a significant difference in conflict monitoring between the two meditator groups where the experienced meditators performed more accurately with a lower RT than the novice meditators. This confirmed the authors' hypothesis that prior experience with meditation may have long-term benefits for attention (Jha et al., 2007). This finding could also indicate that benefits concerning attention are positively correlated with the amount of MM practiced. In other words, increasing practice increases the benefits regarding attention.

Concerning the hypothesis that meditation training would improve performance on the attention task, results revealed that the experienced meditators exhibited improved conflict monitoring (both in accuracy and RT). The MBSR group (i.e., novice meditators) also exhibited improvement in the orienting attention compared to the control group. In addition, results showed that the amount of prior meditation experience corresponded to performance (Jha et al., 2007). This study provides further evidence that meditation improves various aspects of attention and also indicates that the level of experience with meditative practices may contribute to the gains achieved in attention. The method of group selection in several of the studies discussed affords caution regarding the possible confound that individuals with previous experience in meditation may have chosen to practice meditation because they are good at sustained or divided attention. As a result, their performance on an attention task may be due to other factors than meditation alone.

In addition to improving attention, MM has been indicated as a successful treatment for anxiety and depression (Grossman et al., 2004; Kabat-Zinn et al., 1992; Miller et al., 1995; Papageorgiou & Wells, 2000). It has also been beneficial for other health issues and is argued to be an effective complementary intervention technique for a wide range of disorders (Davidson et al., 2003; Grossman et al., 2004; Kabat-Zinn et al., 1992; Kutz, et al., 1985; Miller et al., 1995). Research examining the efficacy of aphasia treatment has suggested that concomitant ailments of depression and anxiety are capable of slowing and may even prevent optimal recovery (Murray & Ray, 2001; Pachalska et al., 1987; Sarno, 1993). Therefore, implementing MM as part of the treatment regimen for aphasia may treat both cognitive deficits, as well as affective conditions of this devastating disorder that afflicts so many.

Kabat-Zinn and colleagues (1992) sought to explore the effects of MBSR on stress and anxiety. Furthermore, the authors aimed to show that a reduction in anxiety is possible for a broad range of individuals and is distinct from other anxiety reducing treatments, such as cognitive behavioral therapy. Kabat-Zinn and colleagues studied 22 individuals diagnosed with anxiety disorder as they participated in an eight-week outpatient MBSR group program. The program consisted of participating in group meditation once a week for eight weeks during which the participants were instructed to also incorporate and practice MM at home and in their everyday lives. Numerous psychological inventories were administered prior to and following treatment to determine if there was a reduction in anxiety. Results reported that 20 of the 22 individuals exhibited improvement on the anxiety and depression scales post intervention (Kabat-Zinn et al., 1992) indicating that MBSR may be an effective means for reducing anxiety and stress in a broad range of individuals.

A follow-up study completed by Miller and colleagues (1995) sought to determine if the effects in stress reduction were maintained in the long-term. The authors administered the same psychological inventories three years following the original study on 18 out of the 22 original participants and found that their scores remained low, indicating sustained reduction in anxiety and stress. Each individual reported practicing the meditation at different amounts, where some had discontinued it completely and some had added additional meditation or medications. The low scores on the psychological inventories revealed that reductions in anxiety and other stress-related issues were maintained, regardless of the amount of meditation still practiced or medication taken (Miller et al., 1995). Though the influence of psychoactive drugs may have impacted the findings for those taking them, it is reasonable to presume that MM may have long-term benefits in the reduction of anxiety and stress.

In conclusion, the presented discussion of the current literature provides a possible explanation for the variation and inconsistency that is often seen among individuals with aphasia during the recovery process. The literature suggests that this variation cannot exclusively be explained by linguistic deficits alone. Rather, research has shown that other cognitive deficits, mainly in attention, may account for this variability (Erickson et al., 1996; Tseng et al., 1993). In fact, it is argued that aphasia itself may be rooted in cognitive deficits such as attention (McNeil et al., 1991). Therefore, direct treatment for these attentional deficits should be explored as a complementary option to traditional language therapy for individuals with aphasia (Helm-Estabrooks, 2002). As MM has been indicated as beneficial for improving divided attention skills in non-brain-damaged individuals (Levy et al., 2001; Rutschman, 2004; Valentine & Sweet, 1999; Wenk-Sormaz, 2005), it can be hypothesized that these benefits could be applied to individuals with aphasia.

### *Summary*

Individuals with aphasia often present with divided attention deficits in addition to their language deficits (Erickson et al., 1996; Marshall et al., 1997; Murray, 1999; Slanksy & McNeil, 1997). The amalgamated nature of cognition requires that treatment for aphasia not only serve language dysfunction, but serve attention deficits as well (Helm-Estabrooks, 2002). There is general agreement in the literature that there is a breakdown at some point in the attention processing system in individuals with aphasia. In order to begin to truly understand the nature of these attention deficits, it is necessary to design tasks that measure attention without confounding linguistic deficits (Erickson et al., 1996). This is especially imperative in individuals with aphasia, as they may have profound linguistic deficits which may decrease performance on a task

involving language processes. In order to ensure that attention is measured separately rather than filtered through linguistic deficits, non-linguistic tasks must be used (Erickson et al., 1996).

In view of the theory that attention processes are damaged themselves in individuals with aphasia, there are three main thoughts as to where the system breaks down. One theory states that there is a limited pool of attention resources that is depleted in individuals with aphasia, and during language production, these individuals are pulling attention from this depleted source. As a result, they are not able to process tasks which require greater demands on attention, i.e., language (Kahneman & Treisman, 1984; McNeil et al., 1990; Murray, 1999). A second theory suggests that there is a failure in the allocation process of attention resources. In other words, fewer overall resources are not the problem, but rather, the problem lies in how those resources are utilized to support cognitive efforts such as language (Kahneman & Treisman, 1984; Murray, 1999; Peach et al., 1994; Wiener et al., 2004). Therefore, when sustained attention is required for more than one stimulus, as in a divided attention task, individuals with aphasia fail to properly allocate attention to each stimulus, thereby performing worse than individuals without brain damage.

Yet another theory suggests that there is a breakdown in the aphasic individual's ability to evaluate task demands. This failure to properly judge how much attention is needed for a certain task then results in an inadequate allocation of attention resources—whether or not these resources are depleted. The research by Clark and Robin (1995), Murray and colleagues (1997a), and Tseng et al. (1993) has suggested that self-rating scores measure expended effort and are accurate representations of the attention resources devoted to the task. Since individuals with aphasia tend to rate difficult tasks (as indicated by their poorer performance when compared to controls) as easy (or requiring less effort), then it can be hypothesized that individuals with

aphasia are inaccurately evaluating task demands. Finally, it must also be acknowledged that the source of attention deficits may be a combination of the above mentioned theories.

The complex nature of language requires an intact processing system in order to achieve the goal of communication. It requires not only intact linguistic systems in the brain, but also requires intact cognitive processes in order to efficiently and effectively send and receive messages. Given that aphasia is defined by deficits in the language areas of the brain, it only follows that deficits in attention would further limit the ability to produce and comprehend language in the everyday environment. The role of speech-language pathologists is to provide individuals with aphasia with the appropriate tools to guide them through the remediation process. While treatment in the therapy room allows for one-on-one interaction in order to help remediate language deficits, it hardly provides a realistic setting for which language is typically used—that is, it lacks the extraneous stimuli that exist in most natural speaking environments. Deficits in attention may then only surface once the individual is required to use language in natural communicative scenarios. Therefore, therapy should not only focus on the remediation of language but also on attention as well if improvements in the ability to communicate are to be successfully maintained.

One possible treatment that could be employed by speech-language pathologists in the therapy setting is MM, a meditative technique that may specifically benefit divided attention. While MM has not yet been evaluated as a treatment for individuals with aphasia, it has been used with populations carrying similar traits and deficits such as ADHD (Arnold, 1999), chronic pain (Kabat-Zinn, 1982), depression (Papageorgiou & Wells, 2000) and anxiety (Kabat-Zinn et al., 1992). In addition, MM has been shown to be effective for treating depression and anxiety—two traits commonly exhibited in individuals with aphasia (Pachalska et al., 1987; Sarno, 1993).

Furthermore, this particular treatment technique has not only been found to enhance attention in non-brain-damaged individuals (Levy et al., 2001; Rutschman, 2004; Valentine & Sweet, 1999; Wenk-Sormaz, 2005), but has also been found to induce relaxation (Kutz et al., 1985). However, the question still remains as to which aspect(s) of MM is (are) responsible for the increases observed in attention. Therefore, this study will not only measure attention, but also assess self-rated measures of relaxation during treatment in order to determine if relaxation is correlated with changes in attention.

### *Purpose*

This study examined the effects of MM training in three individuals with aphasia during a divided attention task. The method and task used in this study were based on Erickson's study (1996), which utilized the non-linguistic task of sorting cards while simultaneously identifying a target complex tone. A subjective scale for measuring SOE was used in order to measure accuracy of task demand evaluation (Clark & Robin, 1995; Murray et al., 1997a; Tseng et al., 1993). In addition, a relaxation measure was collected in order to determine if there was a relationship between relaxation and attention. Given that aphasia is defined by deficits in language, this study intended to follow any effects that MM may have on language. In order to explore possible effects on language, specific linguistic measures were conducted both pre- and post-treatment.

Therefore, the purpose of the present study was to determine if: (a) divided attention improves in individuals with aphasia after MM training, (b) the effects of MM alter monitoring of task demands and overall SOE, and (c) performance on a relaxation scale correlates with changes in attention measures.

*Hypotheses*

It was hypothesized that (a) MM will improve the performance of individuals with aphasia on a non-linguistic divided attention task, (b) MM will improve accuracy of evaluation of task demands, and (c) relaxation will not be the reason for increased performance.

## CHAPTER 3

### METHOD

#### *Experimental Design*

A multiple baseline single-subject ABA design across individuals was used for this study in order to control for possible threats to internal validity, e.g., practice effects (Backman, Harris, Chisholm, & Monette, 1997; Kazdin, 1982; McReynolds & Thompson, 1986). This time-series design attempts to control for practice effects by varying the length of the baseline phase across individuals (Kazdin, 1982). Thus, intervention commences for each individual at different times resulting in varying lengths of baseline, or A1, phases. According to Backman and colleagues (1997), this design is appropriate for studies in which removal of treatment is not possible due to lasting effects of treatment as it attempts to control for extraneous variables.

#### *Participants*

Four individuals between the ages of 45 and 59 with a history of left-hemisphere brain damage were initially included in the study. All participants were recruited from the University of Georgia (UGA) Speech and Hearing Clinic where they received weekly treatment for language deficits. One individual, M.K., did not complete the study for unknown reasons and will therefore not be included in the discussion. All participants completed and passed a hearing screening prior to data collection at the frequencies of 500, 1000, 2000, and 4000 Hz, presented bilaterally at 45dB. In addition, the experimenter administered the Aphasia Diagnostic Profile (ADP) to the participants in order to determine the type and severity of aphasia. It was

determined that all participants exhibited aphasia. A summary of the participants' characteristics can be found in Table 1 and are described below.

Table 1

*Participant Characteristics*

Participant	Gender	Age	Type of aphasia	Months post-onset	Handedness
L.N.	Female	49	Mild Borderline Wernicke's Aphasia	61	Right
J.J.	Male	59	Moderate Wernicke's Aphasia	36	Right
M.W.	Male	51	Mild Anomic Aphasia	96	Right

*Note.* Type of aphasia as determined on the ADP.

*L.N.* *L.N.*, a 49 year old female, suffered an infarct to the left frontal lobe and basal ganglia with involvement in the left temporal lobe due to a CVA in 2003. As a result of the infarct, *L.N.* initially presented with mild Broca's aphasia, verbal apraxia, and dense right hemiplegia. She began therapy at the UGA Speech and Hearing Clinic in 2004 and continues to receive services biweekly each semester for language deficits. Language goals targeted in the clinic during the time of the study included using appropriate syntax, producing descriptive sentences, recalling words, reading aloud, answering content questions from reading material, following directions, performing memory tasks such as remembering to bring certain objects to therapy, and increasing her use of compensatory strategies related to memory impairments. Results from the ADP indicated the presence of borderline Wernicke's aphasia characterized by poor repetition and poor auditory comprehension. It must be noted however, that *L.N.* presented with characteristics more consistent with mixed aphasia with only mild deficits in comprehension and non-fluent speech.

*J.J.* *J.J.*, a 59 year old male, suffered a CVA in 2005 to the left hemisphere resulting in Wernicke's aphasia characterized by mild to moderate deficits in receptive and expressive language. Medical records for *J.J.* were unattainable; therefore, detailed information about damage to the brain was limited. *J.J.* was also diagnosed with deficits in vision including diplopia, optic atrophy, hyperopia, visual field defect, generalized contraction/constriction, and exotropia for which he takes medication and wears glasses. He currently takes Nifedipine ER, Enalapril, and Clonidine for high blood pressure. *J.J.* began therapy at the UGA Speech and Hearing Clinic in 2007 and continues to receive services biweekly each semester for language deficits. Language goals targeted in the clinic during the time of the study included answering questions, naming objects/pictures, formulating syntactically and grammatically correct

sentences in response to “wh” questions, restating functional information from a script, and writing personal information (e.g., name, address, and phone number). Results from the ADP indicated the presence of Wernicke’s aphasia primarily characterized by deficits in auditory comprehension.

*M.W.* M.W., a 51 year old male, suffered a CVA in 2000 resulting in an infarct to the left middle cerebral artery and right frontal cortex. He currently takes the following medications for hypertension and Type II non-insulin dependent diabetes: Digoxin, Cosopt, Furosemide, Norvasc, Diovan, Potchloride, Topral, Counovin, Lumigan, Alphagan, and Glipizide. M.W. began therapy at the UGA Speech and Hearing Clinic in 2002, and he receives services for language deficits once a week each semester. Language goals targeted in the clinic during the time of the study included verbalizing appropriate responses during role play, producing syntactically and grammatically correct sentences, producing complex emotional sentences using appropriate intonational patterns, answering questions from reading, and performing functional writing activities. Results from the ADP revealed the presence of Anomic aphasia primarily characterized by deficits in naming.

### *Materials*

Ten non-target pure tones and one target complex tone with multiple harmonics were created using ToneGen, a downloadable software program which allows the user to create pure tones and harmonics with varying frequencies and amplitudes. Non-targets consisted of pure tones presented at the frequencies 550, 580, 620, 680, 720, 780, 820, 920, and 980 Hz.<sup>2</sup> The target sound was a complex harmonic consisting of the frequencies 500, 1000, 1500, 2000, 2500, and 3000 Hz. The target sound was easily differentiated from the non-target tones. Tones were

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<sup>2</sup> The divided attention methods of this study are a replication of Erickson and colleagues’ (1996) study. Pages 47-49 of this thesis resemble the procedures and specific methods utilized by Erickson. See reference list for complete citation.

generated randomly on a lap-top computer using Super Lab Pro for Windows version 2.0.1. at a rate of onset every 2500 msec and lasted 500 msec, for a total of 24 events per minute. A total of 120 tones were presented over a 5 minute period with a ratio of 1 target tone to every 6 non-target tones, for a total of 14 targets and 89 non-targets. A preview of the tones was presented to the participants each session to determine adequate loudness—that is, adequate loudness was achieved when the experimenter was assured by the participants that they were able to hear the presented tones. All sessions were recorded using a digital video camcorder.

### *Procedure*

*Divided attention measure.* Attention was measured via completion of a divided attention task which involved the simultaneous completion of identifying a target tone and sorting cards. Tones were presented via a lap-top computer placed in front and to the side of the participants. Each participant was instructed by the experimenter as well as through written instructions to identify a specified tone by hitting the space bar on a computer keyboard. A sample of non-target and target tones were presented before each task in order to ensure that the participant was clear about the tone he/she was to identify. The participants were instructed to hit the space bar with their unaffected hand each time they heard the target tone. Data were collected via Super Lab Pro on the RT for the identification of the tone as well as his/her accuracy on identifying the correct tone. Given the limited number of tones presented, it was thought that accuracy was better represented by recording the total number of tones rather than the percent accuracy. Therefore, the total number of tones correctly identified and average RT were calculated for each session.

While identifying tones, the participants simultaneously completed a second task of sorting cards. This task involved sorting cards from the Blink© game card deck. The Blink© cards used included five different shapes, where each shape was green, red, yellow, blue, or

brown. Furthermore, each card contained one, two, three, four, or five shapes. Therefore, each card was sorted either by shape, number, or color. A total of 140 cards were placed in a basket for the participants to sort. Participants were instructed to pick one card at a time from the basket at a self-determined, comfortable rate using their unaffected hand. They were then instructed to sort each card either by its color, shape, or number. The sorting criteria (i.e., color, shape, or number) varied each week in an attempt to reduce practice effects. Cards were continuously sorted for the duration of the presentation of tones over a 5 minute span. Data was collected live by the experimenter on accuracy of sorting cards and number of self-corrections. At the conclusion of the task, the experimenter counted the number of cards the participant sorted and determined accuracy. In addition, a separate judge blind to the phase of the study, also recorded accuracy of the card sorting task in order to ensure interjudge reliability. The judge blind to the phase watched the video recordings at a different time from the experimenter and was not told the phase of the study. A total percent accuracy and average number of cards sorted were calculated each session. The following instructions were borrowed from Erickson et al. (1996) and were verbally presented to the participants prior to each task:

You are about to hear a random series of sounds like this (*sample*). I want you to hit the space bar on the keyboard each time and as soon as you hear this sound (*target tone*).

Listen carefully and try not to miss any. Remember; hit the space bar each time you hear this sound (*target*). While you are listening to the sounds, I want you to sort the cards in front of you by their (*either color, shape, or number will be indicated*) at a rate which is comfortable to you. When we begin, I want you to take a card from the basket and place it on the one with the same (*either color, shape, or number will be indicated*). You must continue to take cards and sort them the entire time the sounds are playing. Remember

also to hit the space bar each time you hear this sound (*target tone*). Listen carefully and try not to miss any. Are you ready? We will begin now. (Erickson et al., 1996, p. 248)

Inter-judge reliability was calculated for the total number of cards sorted for each participant. Tapes of each session were viewed by a separate judge blind to the phase of the study. Reliability calculations for the other measures were attempted but not possible due to technological limitations of the video equipment (i.e., lack of color contrast, glare, etc.) for every tape. Therefore, only the measures that were completed on at least 75 percent of the total data were considered as completed reliability calculations. Reliability for the total number of cards sorted was calculated for 79 percent of the total data for L.N. resulting in a 100 percent agreement. For J.J., reliability for the total number of cards sorted was completed on 90 percent of the total data and resulted in 100 percent agreement. Additionally, 92 percent of M.W.'s data was calculated for inter-judge reliability resulting in 100 percent agreement.

*Sense of effort measure.* Following the divided attention task, each participant completed a 5 point scale (see Appendix A) rating his/her perceived SOE in order to determine the amount of effort expended during the task, where 5 was the greatest amount of effort and 0 was the least amount of effort expended (Erickson et al., 1996; Murray et al., 1997a). Participants marked an "X" on a vertical line at the point they considered to most closely represent their expended effort. The examiner along with another judge determined a numerical value for the participant's mark using a template with ratings labeled in increments of .5 (see Appendix B). If the mark was somewhere in between the designated increments, the value closest to the mark was recorded. Effort was explained to them as the amount of attention and overall cognitive effort that was required to complete the task. Written as well as verbal instructions explaining the scale and defining "effort" were provided prior to the administration of the SOE scale.

*Relaxation measure.* In addition to the SOE scale, a Relaxation Inventory (see Appendix C) was administered to the participants every other session due to its lengthy nature. It consists of a questionnaire comprised of three separate sections totaling 45 items (Crist, Rickard, Prentice-Dunn, & Barker, 1989). The first scale, the physiological tension scale, consists of 15 items containing statements such as “my face feels flushed” and “I am sweating because I am tense.” The cognitive tension scale consists of 10 items including statements such as “I am thinking about all of my problems” and “I seem to be worrying about others.” Finally, the physical assessment scale contains 20 items with statements including “I feel content” and “My muscles are at rest” (Crist et al., 1989). Reliability coefficients for the three scales, physiological tension, physical assessment, and cognitive tension, were .89, .95, and .81, respectively (Crist et al., 1989). Predictive validity for each scale of the Relaxation Inventory was established by determining significant effects in a pretest posttest study utilizing progressive relaxation training.

Due to deficits in reading, items were read to participants. Instructions for responding to the statements in each subtest were modified for participants J.J. and M.W. due to language comprehension difficulties. As such, the experimenter simply asked them to respond to the given statements with “yes” indicating agreement with the statement, “no” indicating disagreement, and “I don’t know” for “neither disagree nor agree.” Subsequently, responses of “yes” were recorded as scores of 1 on the Likert scale, with scores of 5 and 3 recorded for “no” and “I don’t know,” respectively. A sum was determined for each subtest of the Relaxation Inventory resulting in a total score for each section. The highest score possible for the physiological tension scale was 75. A higher score indicated greater agreement with statements associated with relaxation and therefore reliably indicates a relaxed state (Crist et al., 1989). The highest score on the cognitive tension scale was 50, where a higher score indicates agreement with statements

associated with relaxation. For the physical assessment scale, the lowest possible score was 20, where a lower score indicates greater agreement with statements associated with relaxation (Crist et al., 1989).

*Language measure.* An informal language measure was collected pre- and post-treatment in order to determine if MM resulted in improvements in language. Since language deficits manifest in many ways depending on the location of the brain injury and the individual's own characteristics, both receptive and expressive language were assessed informally. If deficits in divided attention contribute to the language deficits seen in aphasia (Alexander, 2006; Erickson et al., 1996; Helm-Estabrooks, 2002, Murray, 1999; Tseng et al., 1993), and MM improves divided attention (Levy et al., 2001; Rutschman, 2004; Valentine & Sweet, 1999; Wenk-Sormaz, 2005), then it can be reasonably predicted that language may improve after practicing MM.

Expressive language was assessed by measuring the Correct Information Units (CIU) of the participants according to a modified procedure described by Nicholas and Brookshire (1993). A CIU can be defined as "words that are intelligible in context, accurate in relation to the picture(s) or topic, and relevant to and informative about the content of the picture(s) or the topic" (Nicholas & Brookshire, 1993, p. 348). A CIU analysis is a standardized scoring method used to analyze the informativeness and efficiency of connected speech in adults with aphasia. Both interjudge reliability and stability were determined to be high when this rule-based system was tested on the connected speech of 20 non-brain-damaged individuals and 20 individuals with aphasia (Nicholas & Brookshire, 1993).

Total word count, time, and CIU counts were used to calculate the following measures (a) words per minute (WPM), (b) percent of words that were correct information units (%CIUs), and (c) correct information units per minute (CIUs/min) (Nicholas & Brookshire, 1993). Speech

samples were recorded via a digital voice recorder. Each sample was analyzed by two individuals including the experimenter and one other trained graduate student. Both judges referred to established rules in order to determine what and what not to count as CIUs. Each analysis was then reviewed by the experimenter to check for agreement. Any disagreements or discrepancies in CIU analysis were discussed until a consensus was reached and CIU calculations were congruent. Scoring CIUs was achieved according to established rules (see Nicholas and Brookshire (1993) for a complete description of analysis). In order to be counted in WPM, words had to be intelligible in context but no other inclusion criteria were assigned. CIUs consisted of a single word which had to be intelligible, accurate, relevant, and informative relative to the elicited stimulus. However, the words did not have to be grammatically correct to be counted as CIUs.

In order to obtain a connected speech sample, the experimenter presented the participants with four stimuli. First, the “cookie theft” picture, from the Boston Diagnostic Aphasia Examination (BDAE) was presented to the participants (Goodglass & Kaplan, 1983). The experimenter then asked the participant to describe what they saw happening in the picture. The picture was placed directly in front of the individual on a table for one minute or until it was indicated by the participant that he/she was done.

In addition, the experimenter presented the participant with a sequence of six pictures depicting a story from the BDAE. Each picture within the sequence was placed in front of the participant in the correct order for 1 minute or until the participant indicated that he/she was done. The experimenter instructed the individual to tell a story using the presented pictures (Nicholas & Brookshire, 1993).

CIUs were also obtained by asking the participant to answer one question about personal information (e.g., “Tell me your favorite hobby”) and by describing one procedural event (e.g., “Tell me how you would make a peanut butter and jelly sandwich”). During the elicitation of personal and procedural information, the experimenter placed a card containing the request written in bold quarter-inch letters in front of the participant for 1 minute or until the participant indicated that he/she was done (Nicholas & Brookshire, 1993).

Receptive language was assessed by using partial subtests of the BDAE. The first section evaluated word discrimination and consisted of eight stimuli in which the participants were asked to identify stimuli nonverbally (e.g., “Show me your elbow”). The second section consisted of following three, one-step verbal commands (e.g., “Look at the ceiling”). In the third section, the participant answered “yes/no” questions (e.g., “Will a cork sink in water?”). Each item tested was scored as either correct or not by the experimenter, obtaining a total percent accuracy for the receptive portion of the language measure.

*Treatment phase B.* Phase B introduced the training of MM (see Appendix D for a complete description). During each treatment session the experimenter trained and guided the participants through MM. Training took place in a comfortable and quiet room at UGA. The experimenter traveled to each of the homes of L.N. and J.J. to conduct treatment per request of the participants during the latter half of the study. The length of the training increased gradually beginning with 5 minutes of practice and building to a practice lasting 30 minutes. In order to ensure that participants were correctly practicing the meditation, the experimenter asked the participants if they felt they were able to follow the instructions for the practice. In addition, the experimenter instructed the participants to practice the meditation at home for gradually increased increments of time. Take-home instructions and guidelines in the form of handouts

were given to all participants (see Appendix D). In addition, a CD recording of guided MM was given to L.N. and M.W. A CD recording was offered to J.J. but not taken. Participants were also instructed to document the amount of time they practiced daily into a log given to them by the experimenter.

Each treatment session began with the practice of MM followed by the completion of the divided attention task and completion of the SOE scale. The Relaxation Inventory was administered every other session. Treatment continued until no visual trends were evident for the accuracy of the tone identification task and card sorting task on at least three data points—that is, treatment continued until there were no stable increases or decreases in the data points.

*Maintenance phase A2.* Movement to phase A2, or the maintenance phase, was determined by reaching 30 minutes of MM practice and stability for both accuracy on the tone identification task and card sorting task. Phase A2 then consisted of the completion of 5 sessions in order to determine if effects of treatment remained stable. It was thought that 5 sessions would allow for a satisfactory observation of any trends that could occur during the maintenance phase. During this phase, direct MM training ceased but data collection for performance on the divided attention task continued. Participants were instructed to continue practicing MM for at least 30 minutes each day on their own. Each session during this phase was identical to the sessions during phase A1.

#### *Data Analyses*

All dependent variables were recorded and graphed each session. Stability and trends in data were analyzed by the experimenter via visual observation of the graph. Movement between phases was dependent on relative stability of at least three data points for accuracy of the tone identification task, card sorting task, and total number of cards sorted. The following variables

were recorded each session and graphed: percent accuracy for sorting cards, the number of target tones correctly identified, total number of cards sorted, RT for the identification of target tones, and SOE rating. A relaxation score was obtained every other session.

## CHAPTER 4

### RESULTS

*L.N.*

L.N. completed a total of 19 sessions over approximately 10 consecutive weeks with the first 10 sessions completed at UGA, and the latter 9 completed in her home. The results for all dependent variables collected for L.N. can be found in Figure 1. Separate figures for each dependent variable can be found in Appendix E. L.N. performed at 100 percent accuracy for the card sorting task through the duration of the study (see Figure 1). The total number of cards sorted ranged from 80 to 130 throughout the study showing no trends in phase B when MM was introduced. The number of target tones identified correctly ranged from 10 to 14 out of 14 possible tones through phases A1, B, and A2. In addition, RT for the tone identification task remained between approximately 1000 ms and 1800 ms during all phases.

L.N.'s SOE ratings in phase A1 ranged from .5 to 3. A notable decrease from 2.5 on session 3 to .5 on session 4 was observed (see Figure 1). SOE then increased to 1.5 for session 5. Phase B resulted in ratings ranging from .5 to 3, with the first session of treatment rated as .5 and the last session rated as 2.5. Phase A2 resulted in ratings ranging from .5 to 2.5 beginning and ending with a rating of 1.5 (see Figure 1).

L.N.'s ratings on the physiological tension scale were consistent throughout phases A1, B, and A2 remaining between scores of 72 and 75 with the exception of session 11, for which she reported a lower score of 62 (see Figure 1). Likewise, the cognitive tension scale remained relatively stable throughout the duration of the study with ratings ranging from 40 to 50. L.N.'s

total score for the physical assessment scale ranged from 20 to 27, with the exception of session 11, which resulted in a total score of 54 (see Figure 1).

Language testing for L.N. revealed a 10 percent decrease in performance on the receptive language score from 84 percent pre-treatment to 74 percent post-treatment (see Table 2). WPM increased slightly from .91 to .97 pre- and post-treatment, respectively indicating an improvement in the amount of words produced during the sample. Percent CIUs decreased from 65 percent pre-treatment to 59 percent post indicating slightly less accuracy of the content in the language sample. Likewise, CIUs/min decreased slightly with .64 pre-treatment and .62 post-treatment indicating a slight reduction in the accuracy and efficiency of content expressed (see Table 2).

*J.J.*

J.J. completed a total of 21 sessions over 11 consecutive weeks with the first 9 completed at UGA, and the latter 12 completed in his home. The results for all dependent variables collected for J.J. can be found in Figure 2. J.J. exhibited a percent accuracy ranging from 90 to 100 percent correct during the card sorting task through the duration of the study (see Figure 2). The total number of cards sorted ranged from approximately 31 to 80 throughout the study with no visual trends evident. The number of tones identified correctly ranged from 9 to 14 although J.J. identified 13 or 14 tones during the majority of the sessions. Finally, RT for tone identification exhibited relative stability ranging from approximately 1600 ms to 2400 ms through all phases.

J.J.'s SOE ratings in phase A1 ranged from 2 to 3, beginning at 2.5 and remaining relatively stable throughout baseline (see Figure 2). Phase B resulted in ratings ranging from 2 to

3.5, with the first session of treatment rated as 3.5 and the last session rated as 2.5. Phase A2 ranged from 1.5 to 2.5 beginning with a rating of 2.5 and ending at 1.5 (see Figure 2).

J.J.'s ratings on the physiological tension scale were also relatively consistent throughout the duration of the study remaining between 66 and 75 (see Figure 2). Likewise, the cognitive tension scale remained relatively stable throughout the duration of the study with ratings ranging from 39 to 50. Session one resulted in a score of 30; though, results must be interpreted with caution, as the participant exhibited some confusion with the initial administration of this scale. J.J.'s total score for the physical assessment scale ranged from 20 to 24, with the exception of session one again, which resulted in a total score of 32 (see Figure 2).

Language testing for J.J. revealed a 7 percent decrease in the receptive language score from 68 percent pre-treatment to 61 percent post-treatment (see Table 2). WPM increased from .97 to 1.65 pre- and post-treatment, respectively indicating an improvement in the amount of words produced during the sample. Percent CIUs increased slightly from 61 percent to 65 percent post-treatment indicating an overall improvement in accurate content conveyed in the sample. An increase was also noted in post-treatment testing for CIUs/min with pre-treatment resulting in .61 CIUs/min and post-treatment resulting in .89 CIUs/min indicating an increase in the amount of meaningful context expressed (see Table 2).

*M.W.*

M.W. completed a total of 26 sessions over 13 consecutive weeks at UGA. The results for all dependent variables collected for M.W. can be found in Figure 3. Percent accuracy on the card sorting task ranged from approximately 98 percent to 100 percent through all phases of the study (see Figure 3). The total number of cards sorted during phase A1 began with 66 increasing to 123 before dropping to 70 at the end of baseline. The number of cards sorted continued to

exhibit variability in phases B and A2 ranging from approximately 80 to 130 cards. The number of tones identified correctly ranged from 10 to 14 throughout the study with a decrease once to 4 tones during session 24 in phase A2. In addition, RT for target tone identification exhibited relative stability through all phases of the study ranging from approximately 1100 ms to 1700 ms.

M.W.'s SOE ratings in phase A1 ranged from 2 to 5, beginning at 2 and then increasing to 5 on session 10, ending baseline with a rating of 4.5. (see Figure 3). Phase B resulted in ratings ranging from 0 to 4, with the first session of treatment rated as 2 and the last session rated as .5. Phase A2 began with a rating of 0 then increased to 3.5. on sessions 23 and 24. A sharp decrease to .5 followed on session 25, and maintenance ended with an increase to 4 (see Figure 3).

M.W.'s ratings remained relatively consistent during phases A1, B, and A2. Ratings on the physiological tension scale ranged from 52 to 75 (see Figure 3). His total scores for the cognitive tension scale resulted in ratings ranging from 22 to 42. M.W.'s total score for the physical assessment scale generally ranged from 20 to 28, with the exception of session one, which resulted in a total score of 63 (see Figure 3).

Language testing for M.W. revealed a 3 percent decrease in the receptive language score from 90 percent pre-treatment to 87 percent post-treatment (see Table 2). WPM decreased from 1.28 to 1.17 pre- and post-treatment, respectively indicating fewer words expressed during the sample. Percent CIUs decreased slightly from 86 percent pre-treatment to 84 percent post indicating slightly less accuracy of the content in the language sample. Likewise, CIUs/min decreased slightly with 1.07 pre-treatment and 1.0 post indicating a slight reduction in the accuracy and efficiency of content expressed (see Table 2).

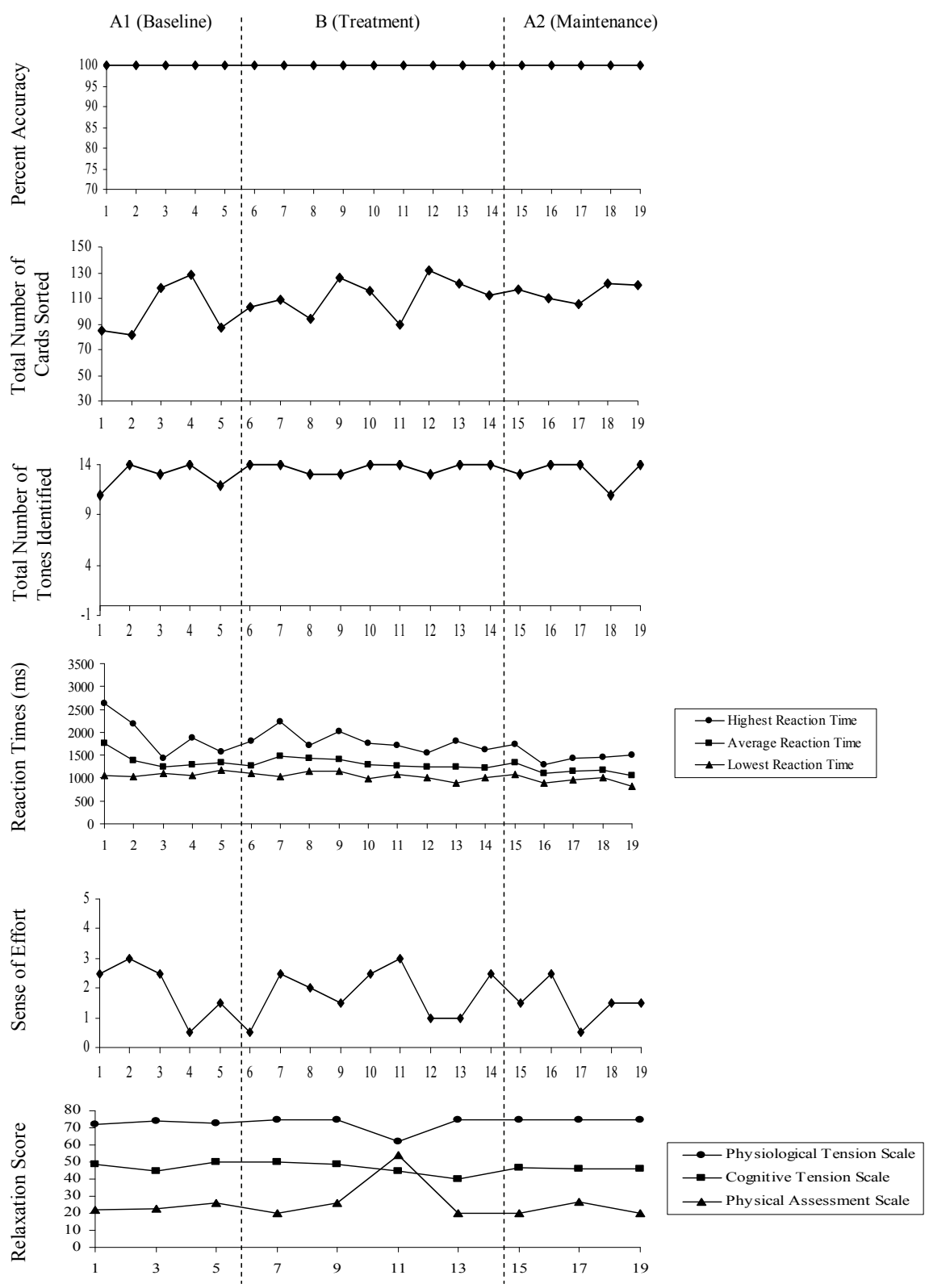


Figure 1. Performance on dependent variables for L.N.

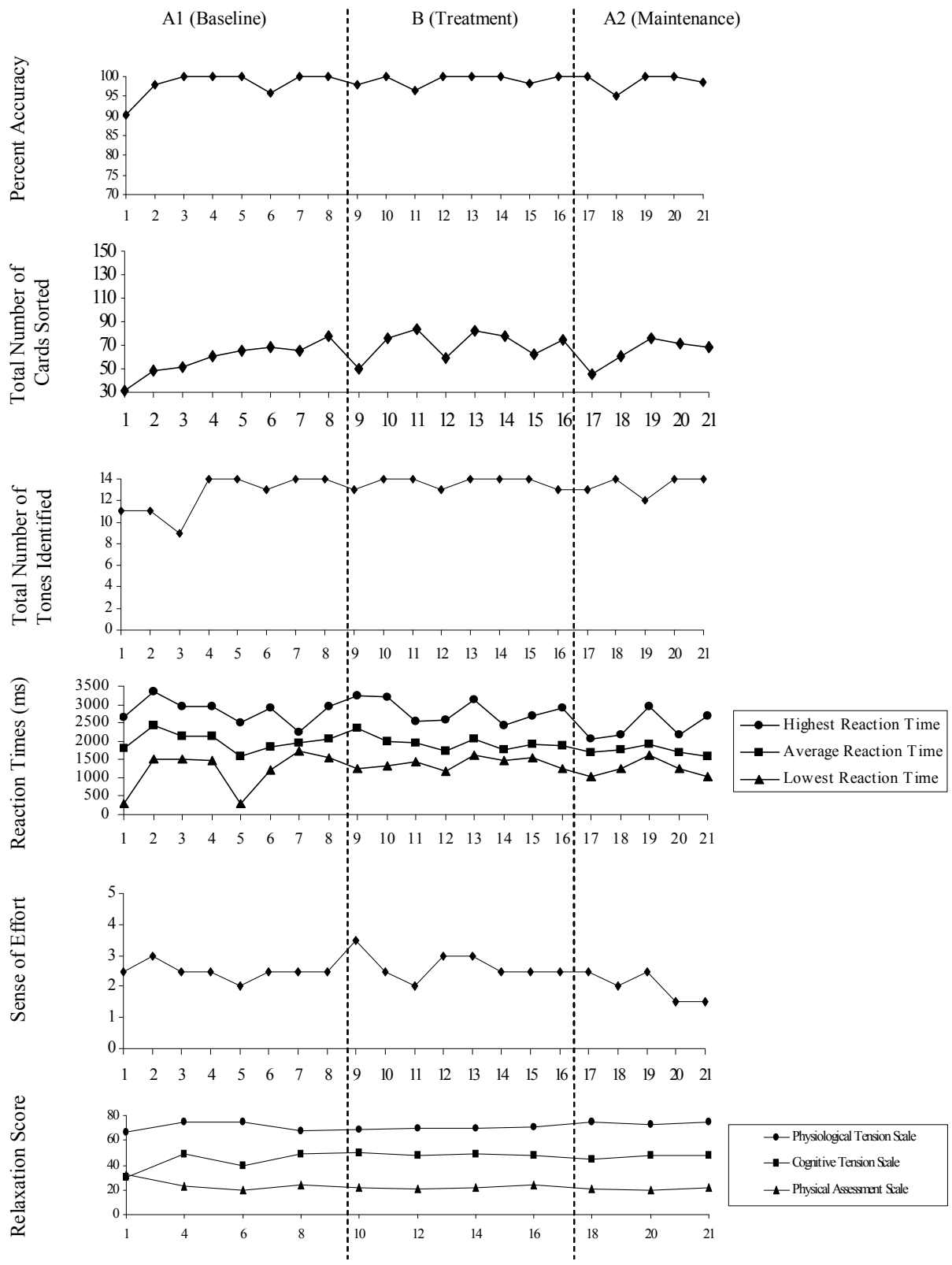


Figure 2. Performance on dependent variables for J.J.

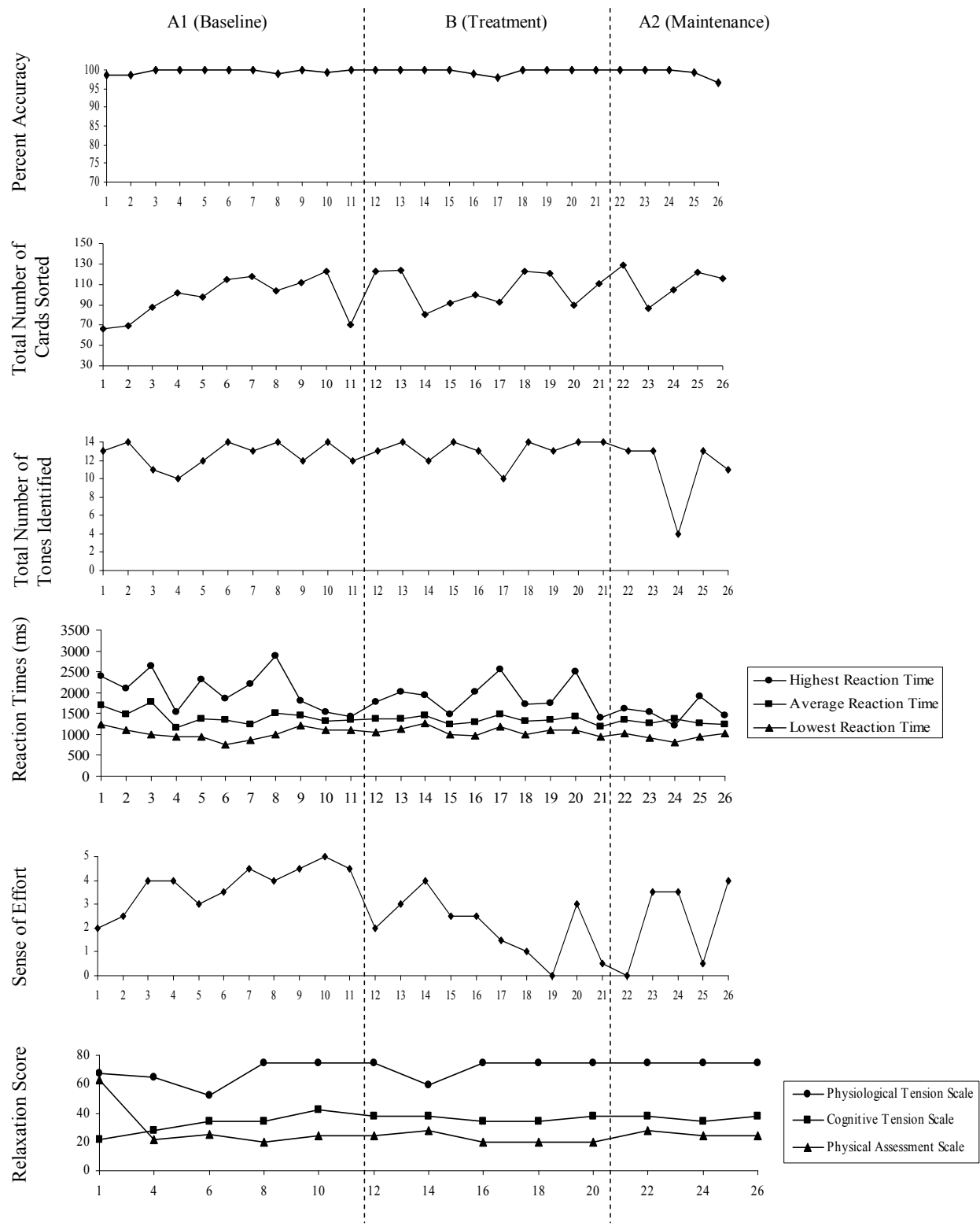


Figure 3. Performance on dependent variables for M.W.

Table 2

*Pre- and Post-treatment Language Scores*

Participant	Pre-treatment				Post-treatment			
	Receptive language score	WPM	%CIUs	CIUs/min.	Receptive language score	WPM	%CIUs	CIUs/min.
L.N.	84%	.91	65%	.64	74%	.97	59%	.62
J.J.	68%	.97	61%	.61	61%	1.65	65%	.89
M.W.	90%	1.28	86%	1.07	87%	1.17	84%	1.0

*Note.* WPM = words per minute; CIU = correct information unit.

## CHAPTER 5

### DISCUSSION

#### *Summary of Results*

The present study sought to answer the following questions regarding the effects of MM on individuals with aphasia: (a) does performance on a divided attention task improve following MM training, (b) does MM alter monitoring of task demands and overall SOE, and (c) does relaxation correspond to changes in attention following MM? The results of the above questions are described for each participant below.

*L.N.* As displayed in Figure 1, all dependent variables collected during the divided attention task remained relatively stable through the duration of the study. Performance on both the card sorting task and target tone identification task reached maximum accuracy within the first few sessions resulting in minimal room for improvement. Consequently, other dependent variables such as the number of cards sorted and RT for tone identification were examined to note any effects of treatment on performance. Upon visual inspection (see Figure 1), the total number of cards sorted in phase A2 increases slightly compared to phase A1 while phase B fluctuates randomly resulting in no systematic increase or decrease. It appears that the number of cards sorted increases on session 9 of phase B and then decreases for 2 sessions until a second increase is observed on session 12. Following a similar pattern, the number of cards sorted decreases slightly after session 12 for 2 sessions resulting in an increasing/decreasing pattern for phase B. The number of cards sorted in phase A2 results in a less variable pattern consistent with approximately the greatest amount of cards sorted in phase A1. The average RT slightly

decreases in phase A2 compared to phases A1 and B. Similar to the total number of cards sorted, RT for the tone task appears to stabilize in phase B at approximately the lowest RT achieved in phase A1 (see Figure 1).

Upon visual inspection of L.N.'s SOE ratings over three phases (see Figure 1), no clear or obvious trends are evident. In addition, her SOE ratings do not appear to correspond with her performance on any of the four dependent variables examined. That is, she did not rate the task as less effortful when her performance was high, nor did she rate the task as more effortful when performance decreased (see Figure 1). Likewise, she did not rate a high performance with high effort (i.e., as difficult) or a poor performance with a low rating (i.e., as easy).

L.N.'s perception of relaxation appears to remain relatively stable throughout all phases of the study (see Figure 1). With the exception of session 11, no observable changes are noted between phases. It must be noted, that session 11 was the first session in L.N.'s home where many distractions were present during the practice of MM. Measures of relaxation do not appear to correspond with any of the dependent variables used to measure attention. In addition, the graphs do not indicate that the introduction of MM in phase B had any effect on relaxation. Therefore, relaxation did not increase or decrease as a result of MM training and practice.

*J.J.* As displayed in Figure 2, all dependent variables collected during the divided attention task remained relatively stable through the duration of the study. Performance on both the card sorting task and target tone identification task reached maximum accuracy within the first few sessions of baseline resulting in a minimal amount of room for improvement (see Figure 2). Upon visual inspection (see Figure 2), the total number of cards sorted in A1 appears to increase slightly and then fluctuate during phase B. The number of cards sorted then rises slightly in phase A2 ending in a downward slope. Average RT of the tone identification task

follows a similar pattern of instability in phase B followed by a slight downward trend in phase A2 ending in relative stability at the lowest RT observed in baseline (see Figure 2).

J.J.'s perceived SOE appears to remain relatively stable throughout the study (see Figure 2). However, there is a slight decrease in SOE during phase A2 compared to phases A1 and B. When comparing the ratings for SOE to the other dependent variables during all phases of the study (i.e., percent accuracy, number of tones identified, number of cards sorted, and RT), it is evident that a higher SOE was reported when performance accuracy decreased, especially during session nine (see Figure 2). That is, J.J.'s effort rating increased when the number of tones identified decreased, number of cards sorted decreased, and RT increased. As a result, it may be concluded that J.J. has an accurate perception of task demand.

With the exception of the first session, J.J.'s relaxation ratings appear to remain stable throughout the study, showing no change when MM was practiced immediately prior to completion of the task or practiced outside of the session (see Figure 2). In addition, the graphs do not indicate that the introduction of MM in phase B resulted in any changes in relaxation. That is, relaxation neither increased nor decreased as a result of MM training and practice.

*M.W.* When assessing performance on the divided attention task pre- and post-treatment, it is evident from visual observation that performance remained relatively stable throughout the duration of the study (see Figure 3). With the exception of session 24 on the target tone identification task (see Figure 3), performance on this task remained variable but relatively accurate throughout the study reaching maximum performance. Performance on both the card sorting task and target tone identification task reached maximum accuracy within the first few sessions resulting in a minimal amount of room for improvement (see Figure 3). The slight increase in the total number of cards sorted is evident in phase A1 indicating possible practice

effects (see Figure 3). However, in phase B and A2, performance fluctuates resulting in no observable trend making practice effects unlikely. RT for M.W. fluctuates at the start of baseline and then stabilizes before the commencement of treatment. During phase B and A2, RT remains relatively stable resulting in no observable pattern following the implementation of MM.

M.W. began the study with relatively high ratings on the SOE scale during phase A1 (see Figure 3). SOE is variable in phase B but a general decrease is evident. Phase A2 then exhibits variability across all five sessions. In regards to SOE representing task performance, M.W.'s ratings were generally consistent with his performance (see Figure 3). For instance, in sessions 14 and 24, M.W. demonstrated greater awareness of the degree of extended effort when performance decreased. As a result, it may be concluded that M.W. has an accurate perception of task demand.

Similar to the other participants, M.W.'s ratings on the Relaxation Inventory remained relatively stable with no observable trend noted between phases. Though his scores on the cognitive tension scale were generally lower than the other participants, indicating less relaxation, his overall relaxation ratings appear to remain stable throughout the study. With the exception of the first session, no changes in scores were observed when MM was practiced immediately prior to completion of the task or practiced outside of the session (see Figure 3).

### *Interpretation of Findings*

*Attention and mindfulness meditation.* The performance on the divided attention task yielded several observations. First, all 3 participants performed close to the ceiling for the card sorting task and the number of target tones identified correctly reaching plateau within the first phase. As a result, there was limited room for improvement making the effects of MM difficult to interpret on these two variables. The high performance exhibited on this particular task leads

to the significant finding that attention deficits were not seen in these individuals. This is contrary to the findings of Erickson and colleagues' (1996) study which found that the mean number of targets identified for the aphasic group was less than half that of the control group (i.e., 100% for the control group and 39% for the aphasic group) indicating that individuals with aphasia did indeed present with attention deficits. Perhaps these contrary findings are testament to the individual differences evident in individuals with aphasia.

Differing methodology could also explain the differing findings. For instance, the task used in the present study only differed from Erickson's study in its duration. While Erickson's divided attention task lasted for 10 minutes, the present task lasted for only 5. One potential interpretation in the differential performance is that deficits only become apparent during tasks of longer duration. If the duration of the task is a contributing factor to the decreased performance observed in Erickson's study, then it may be possible that individuals with aphasia experience deficits in sustained attention during nonlinguistic tasks, rather than divided attention as claimed. There was no information regarding the timing of errors in Erickson's study and therefore conclusions about the data may not be inferred. The 5 minute divided attention task used in this study may not have challenged the attention system to the point that existing deficits were observed—hence the early plateau of performance.

Other differences between the present study and Erickson and colleagues' (1996) study could potentially explain the differing findings. For example, the participants with aphasia in Erickson's study were relatively early post-onset of injury (3 to 11 months). In addition, all participants were determined to have characteristics typically associated with Broca's aphasia (i.e., nonfluent speech and relatively intact comprehension). However, it should be noted that Murray (2000) found that lesion location was not a significant determinant for the presence of

attention deficits in individuals with aphasia. Given that the participants in the present study had longer time post-onsets of injury and different types of aphasia (e.g., Anomic, Wernicke's, etc.) it may be possible that these are significant determinants of the existence of attentional impairment in individuals with aphasia. Degree of the severity of aphasia was not controlled for in Erickson's study; and therefore, the impact of this factor on attention deficits remains questionable.

The degree of severity of attentional impairment also needs to be addressed as a possible factor for the differing results in this study compared to Erickson et al.'s (1996) study. For example, individuals with aphasia and concomitant mild deficits in attention may perform within normal limits when the divided attention task does not require language; however, these same individuals may exhibit deficits when required to complete divided attention tasks that have a linguistic component. Likewise, individuals with greater degrees of attention deficits may show decreased performance on even non-linguistic tasks, as in Erickson's study. The use of group design in Erickson's study limits the conclusions that can be made regarding individual differences and their affect on task performance. For instance, while the use of statistics found significant deficits in attention compared to a control group, there was no information presented which looked at severity of attention impairment. The possibility of individual variance in the degree of attentional deficits further addresses the need for additional research to determine if all individuals with aphasia have concomitant deficits in attention or if those deficits are reliant on the type, severity, and/or time post-onset of the aphasia.

In order to further evaluate performance on the attention tasks, other variables including RT for the tone task and the total number of cards sorted were analyzed. Visual analyses of these variables revealed no obvious changes as a result of MM. One possibility for the lack of

improved performance on these measures could be that the potential benefits of MM take longer than 4 to 8 weeks to take effect. Furthermore, training took place only twice a week, where a more intensive schedule might have resulted in different outcomes. Therefore, it is possible that the amount of training and/or the intensity of training correlate with affects on attention. The question remains as to how much training is required before improvements, if any, are evident. This is consistent with previous studies which found that more improvements were observed in attention in long-term meditators compared to novices (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; Dunn et al., 1999; Jha et al., 2007). Therefore, future studies should evaluate the effects of MM treatment over a longer duration of time in individuals with aphasia.

It should also be considered that MM may not afford the intensity of attention training that is necessary for gains to be acquired in individuals with aphasia. Perhaps individuals with aphasia require a more direct approach to remediating these deficits. Levy et al. (2001) achieved gains in performance by directing their participants to focus on shifting attention between multiple stimuli (see literature review). In other words, attention was targeted directly by instructing the participants to learn new information in conjunction with monitoring their attention. It is possible that MM may target attention, but on a level which is too abstract or indirect for individuals with aphasia.

It must be noted that deficits in receptive and expressive communication evident in aphasia could have limited the potential benefits of MM. For example, not only could the linguistic presentation of MM restrict the participants' receptiveness to it, but the participants could have been restricted in their ability to form questions and convey concerns to the experimenter during practice. Ultimately, there is no way of truly evaluating the accuracy of MM

practiced in both non-brain-damaged individuals and in individuals with brain damage. While attempts were made to ensure that MM was being applied appropriately (i.e., asking the participants to rate the amount of compliance to MM procedure), there was no way of confirming that they were indeed following the procedures of MM accurately.

Alternatively, it is possible that MM does not improve attention in individuals with aphasia. While previous research has suggested that attention may improve following training in MM, the same effect was not replicated in the present study. The question arises if MM was responsible for the benefits observed in attention in the previous studies or if other factors (e.g., age, personality, etc.) contributed to the results observed. For example, the experience of the MM trainer could be a significant factor in the outcomes achieved. Just as the effectiveness of language therapy may be affected by the clinician's prior experience and training, so may the effects of MM be influenced by the trainer's degree of experience. Furthermore, the research available on MM has thus far been limited to individuals without brain damage or those with TBI. As a result, the effects of MM are limited pertaining to a disordered attention system specific to individuals with left hemisphere damage. Future research should evaluate differences in training attention in intact and disordered cognition.

*Sense of effort and mindfulness meditation.* As previously discussed, other studies have suggested that individuals with aphasia may exhibit reduced performance on divided attention tasks due to an inaccurate evaluation of task demands, i.e., SOE (Clark & Robin, 1995; Murray et al., 1997a; Tseng et al., 1993). This study did not show decreased SOE (see Figures 8-10). In other words, the participants in this study generally claimed that more effort was needed during the tasks for which performance accuracy was low. Likewise, they rated their effort as less, when performance was high. This finding offers several implications regarding the source of attention

deficits in individuals with aphasia. Given that the participants in this study did not exhibit a decrease in task performance, it may be inferred that SOE, rather than attention, is the true cause for decreased performance on divided attention tasks. In other words, if a decreased SOE results in decreased task performance, intact SOE should result in typical performance.

Another possibility for the differing findings could be due to the methodology of measuring SOE. For example, Clark and Robin (1995) used a scale ranging from 0 to 200 and the present study used a scale rated 0 to 5. Simplifying the scale could have reduced the amount of sensitivity. That is, participants were restricted to a 5-point rating scale compared to 200 points.

*Relaxation and attention.* All 3 participants exhibited no obvious trends on measures of relaxation from phase A1 through phase A2. That is, relaxation did not increase or decrease as a result of the training in MM. It has been established that meditation is associated with increased perception of relaxation (Lazar et al., 2000) and several possibilities exist to explain the absence of increased relaxation in this study. First, the fact that the instrument used to measure relaxation was modified from its original form affords caution with interpretation of results. It must be noted that the experimenter observed consistent confusion with the participants during administration of the Relaxation Inventory. As a result, the method for administering the inventory was modified and made simpler. For instance, participants responded to presented stimuli with “yes/no” rather than numerals on a Likert scale as was originally intended. Sensitivity of the scale was thus greatly reduced as a result of modifying the procedure. Thus, the reliability standards previously established for the Relaxation Inventory were not applicable in this study. As a result, it is possible that relaxation was not accurately conveyed in the data. Perhaps an alternative non-linguistic measure of relaxation (e.g., heart rate, cortisol level, etc.)

would be more appropriate for individuals with language deficits than linguistically based measures such as a questionnaire.

Second, it is possible that MM did not result in increased relaxation in these individuals. Previous studies hypothesized that improvements observed in attention were due to the effects of MM as opposed to other forms of meditation or practices invoking a relaxation response (Rutschman, 2004). Therefore, it was hypothesized that an increase in relaxation was not the reason for any changes observed in attention, but the specific nature of MM itself. Since no changes in relaxation were observed in this study and no dramatic improvements were found in task performance (i.e., decreased RT or increased total number of cards sorted), it is possible that relaxation contributes to the improvements in attention that were evident in previous studies. Additional research utilizing valid controls for relaxation and non-altered measures are needed in order to investigate this discussion further.

*Language and attention.* The results of this study revealed no significant improvements in language performance as a result of training in MM, and in fact, decreases in performance were found on some measures. It is noteworthy that these individuals were in language therapy during the time of the study and no improvements were seen in language. Perhaps this finding is testament to the reduced ability for change in chronic aphasia. Future studies should evaluate the effectiveness of treatment for attention and language in individuals with chronic aphasia versus a more acute onset.

### *Limitations*

There are several significant limitations to note. As mentioned earlier, the fact that all participants were receiving therapy during the study makes it difficult to generate conclusions regarding the impact of MM on language. As a result, future studies should consider the effects

of direct attention treatment on language by using participants with aphasia who are not receiving language therapy. Despite the fact that all 3 participants were receiving language therapy, no improvements were observed regarding language. Perhaps the lack of improvement in language is testament to the plateau of performance often observed in long time post-onset of injury (Robey, 1998). In fact, the amount of time post-onset of injury was longer in comparison to previous studies. Not only could this variable impact the amount of improvement possible in the participants' performance but it could also explain differences in performances on the divided attention task. Perhaps attention deficits decrease as time post-onset increases. Differential time post-onset may also explain the lack of improvement evident on the language measures (see Table 2).

The very nature of aphasia affords certain modifications to linguistically based materials (i.e., Relaxation Inventory). As a result, sensitivity and established reliability and validity standards are sacrificed. Due in part to assessment modifications during this study, firm conclusions can not be drawn.

An additional limitation that must be considered results from the restricted number of participants used as this was a single-subject design. While a single-subject design allows for the observation of specific behaviors over time, it limits the ability to generalize the findings. Therefore, results from this study should not be generalized to all individuals with aphasia. The use of group design may be beneficial for this type of study which requires multiple completions of a task over an extended period of time thereby increasing the likelihood of practice effects. Utilizing a group design would eliminate the potential for practice effects to occur in that participants would only be required to complete the task pre/post-treatment.

### *General Conclusions*

Previous studies found that individuals with aphasia may exhibit attention deficits, and that these attention deficits may contribute to the language difficulties and the ability to generalize skills (Helm-Estabrooks, 2002; McNeil et al., 1991; Murray et al., 1997b; Murray et al., 1998; Murray, 2000; Patel et al., 2002; Ramsberger, 2005; Slansky & McNeil, 1997). Specifically, Erickson and colleagues (1996) determined that individuals with aphasia exhibit deficits in divided attention as demonstrated by poorer performance on a divided attention task compared to controls with no brain damage. The present study sought to replicate Erickson et al. (1996) in a single-subject study across three individuals. In addition, it was hypothesized that MM, found to improve attention in various populations (Davidson et al., 1976; Jha et al., 2007; Rutschman, 2004; Valentine & Sweet, 1999; Wenk-Sormaz, 2005), might improve the performance on a divided attention task in these 3 individuals with aphasia.

Based on the results from the present study, the effects of MM on divided attention were not evident. Further studies are needed utilizing an increased number of participants over a greater length of time in order to determine if there are possible attentional benefits from practicing MM in individuals with aphasia. In addition, screening for attention deficits and also decreased SOE in potential participants would help guarantee that only individuals with deficits are included. It is noteworthy that previous studies did not report the use of such a screen and still found attention deficits in individuals with aphasia (Murray et al., 1997b). Again, individual characteristic differences could account for this difference.

Questions still remain regarding the extent and nature of attention deficits in individuals with aphasia. While removing the linguistic element to measure divided attention deficits revealed decreased performance compared to controls in Erickson's (1996) study, the same

deficits were not exhibited in the present study. Perhaps there are varying degrees of attentional impairment in individuals with aphasia that have yet to be examined.

In addition, the present study was unable to replicate the finding that individuals with aphasia present with deficits in the evaluation of task demand (Clarke & Robin, 1996; Murray et al., 1997a; Tseng et al., 1993). While the cause for these differing findings can only be speculated, future research should examine the relationship between evaluation of task demand (i.e., SOE) and the allocation of attentional resources. Finally, the present study found no changes in relaxation. Yet, the difficulties in administering the chosen measure warrant the need for future studies, which utilize alternative means of evaluating the effects of relaxation on attention.

In conclusion, this study explored and evaluated multiple aspects of aphasia including the presentation of deficits in divided attention. While recovery is evident in many cases of aphasia, countless more individuals leave the rehabilitative setting with continued difficulties in communication. As long as deficits in attention continue to be untreated during the acute stage of recovery, patients with aphasia will continue to achieve less than optimal gains. The results of this study provide further evidence to the necessity of future research direction in divided attention and its impact on patient performance. Future studies examining attention deficits, the effects of relaxation on attention, and the interaction between language and attention are necessary in order to understand more about aphasia and consequently, ascertain the most efficient and effective treatments for aphasia in the rehabilitative setting.

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## Appendix A

*Sense of Effort Measure*

Mark an *X* on the line that shows the amount of thinking, or mental effort, it took to complete the task. For example, if it took a great amount of mental effort/thinking, then mark an *X* towards the top of the line around 5. If it did not take much mental effort/thinking, then mark an *X* towards the bottom of the line around 0.

The most amount of effort possible

5

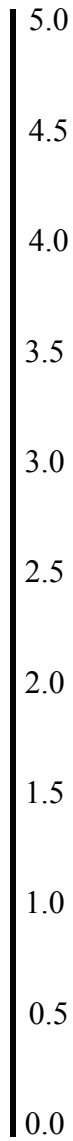


0

The least amount of effort possible

Appendix B

*Sense of Effort Rating Template*



## Appendix C

*The Relaxation Inventory*

Taken from (Crist et al., 1989)

1 Strongly Agree, 2 Agree, 3 Neither Agree nor Disagree, 4 Disagree, 5 Strongly Disagree

Physiological Tension Scale:

\_\_\_\_\_ My face feels flushed.

\_\_\_\_\_ My forehead feels tense.

\_\_\_\_\_ I am sweating because I am tense.

\_\_\_\_\_ I feel somewhat hot.

\_\_\_\_\_ I feel hot.

\_\_\_\_\_ I seem to be perspiring more than usual.

\_\_\_\_\_ My palms are sweaty.

\_\_\_\_\_ My breathing is faster than normal.

\_\_\_\_\_ My breathing is accelerated.

\_\_\_\_\_ My jaw is set tight.

\_\_\_\_\_ Some of my muscles seem to be on the verge of cramping.

\_\_\_\_\_ My heart rate is increasing.

\_\_\_\_\_ The muscles in my back are tense.

\_\_\_\_\_ I feel a headache coming on.

\_\_\_\_\_ My heart is beating faster than usual.

Total Score \_\_\_\_\_ [*to be completed by examiner*]

Physical Assessment Scale:

\_\_\_\_\_ My muscles feel loose.

- \_\_\_\_\_ My whole body is at rest.
- \_\_\_\_\_ I feel content.
- \_\_\_\_\_ I feel very peaceful.
- \_\_\_\_\_ My body feels loose.
- \_\_\_\_\_ I feel a kind of peacefulness.
- \_\_\_\_\_ My muscles feel relaxed.
- \_\_\_\_\_ I feel really easy going right now.
- \_\_\_\_\_ I feel very calm.
- \_\_\_\_\_ I feel a sense of tranquility throughout my body.
- \_\_\_\_\_ I feel very relaxed.
- \_\_\_\_\_ I feel serene.
- \_\_\_\_\_ I feel really laid back.
- \_\_\_\_\_ I feel extremely comfortable.
- \_\_\_\_\_ I feel limber.
- \_\_\_\_\_ I have a clear mind.
- \_\_\_\_\_ My muscles are at rest.
- \_\_\_\_\_ Very few things would bother me now.
- \_\_\_\_\_ I feel no tension in my muscles at all.
- \_\_\_\_\_ I feel refreshed.

Total Score \_\_\_\_\_ [*to be completed by examiner*]

The Cognitive Tension Scale:

- \_\_\_\_\_ Thoughts of failure seem to be creeping into my mind.
- \_\_\_\_\_ I am thinking about my problems.

\_\_\_\_\_ I am really concerned about all of my problems right now.

\_\_\_\_\_ I feel a little scared.

\_\_\_\_\_ I am thinking about the future.

\_\_\_\_\_ I feel like I am in a state of mental strain.

\_\_\_\_\_ I am thinking about my career.

\_\_\_\_\_ I am worried about how much money I have.

\_\_\_\_\_ I don't want others to know what I am feeling.

\_\_\_\_\_ I seem to be worrying about others.

Total Score \_\_\_\_\_ [*to be completed by examiner*]

## Appendix D

### *Description and Procedure of Mindfulness Training*

Developed in conjunction with Rebecca Shisler Marshall, Ph.D. and Rich Panico, MD.

- Session 1- Introduction to the 3-part breath for 5 minutes
  - After stroke or other brain damage, many normal everyday functions of the body are disrupted. Research has demonstrated significant improvement of brain function with meditation techniques for normal individuals and for individuals with depression and anxiety. Unfortunately, this has not yet been applied to individuals who have had a stroke. This project consists of forward thinking treatment; we are doing research to determine if traditional mindful meditation practices can benefit individuals after a stroke.
  - Part of the intent of this study is to look at the healing process that is internally located. This is different than going to a doctor's office---you are the authority. We are starting this treatment with the intent to help the healing process. No matter what other treatments you are receiving or how long ago the stroke happened, we want the intent for these next four weeks together to be on healing.
  - We believe the amount of time spent practicing is directly related to the amount of healing that will take place. The more time you spend meditating, the more improvements that will be seen. Our bodies have the natural ability to heal themselves. Part of what we are doing in this study is waking up our innate ability to heal ourselves.
  - The Practice Sheet is for you to fill out the amount of practice you complete at home. For each day, mark the number of minutes you have completed mindfulness

meditation. Today you completed 5 minutes, so there is an X on day one at 5 minutes.

If you practice for 6 minutes tomorrow, you would mark 6 minutes.

- Session 2- Introduction to mindfulness meditation for 5-10 minutes
  - Now we are going to add another component to the 3-part breath
  - During meditation practice, you may notice that things come up...distractions, pain, boredom, etc. You don't need to do anything, just notice. Watch how the mind comes up with distractions as you attempt to sit. Just notice. If you get caught up in your thoughts bring you thought back to the breath—the way it feels on your nostril, the movement of the abdomen, or even the feeling of warmth and coolness on you upper lip. This may happen over and over which is perfectly fine. Just notice the thoughts and gently bring your mind back to the breath.
  - Remember to continue to fill out your practice sheet.

Homework GOAL= 5-10 minutes of mindfulness meditation (4 days a week).

- Session 3- Increase time on mindfulness meditation to 15-20 min
  - For the rest of this week, increase the practice time for homework up to 15 - 20 minutes per day. This can be accomplished in multiple sessions. Divide the amount anyway you need to (2, 10 minute sessions; or 3, 6 minute sessions, etc.).
  - Please remember to record the total amount of time you spend practicing mindfulness everyday. Remember, we believe that the time spent in mindfulness meditation is directly related to the size of healing effect.
- Session 4- Increase time with mindfulness meditation to 20-25min

- Please remember to record the total amount of time you spend practicing mindfulness everyday. Remember, we believe that the time spent in mindfulness meditation is directly related to the size of healing effect.

Homework GOAL= 15-20 minutes of mindfulness meditation (4 days a week)

- Session 5- Practice mindfulness meditation for 25-30 minutes daily.
  - Remember, if it is too long to do it all at once, you can break it into two shorter sessions (2, 10-15 minutes sessions). Please record the total amount of time you spend and your perception of accuracy in practice.
  - Please remember to record the total amount of time you spend practicing mindfulness everyday. Remember, we believe that the time spent in mindfulness meditation is directly related to the size of healing effect.

Homework GOAL= 25-30 minutes of mindfulness meditation (4 days a week)

## Appendix E

*Participant Data for Dependent Variables Across Phases and Sessions*

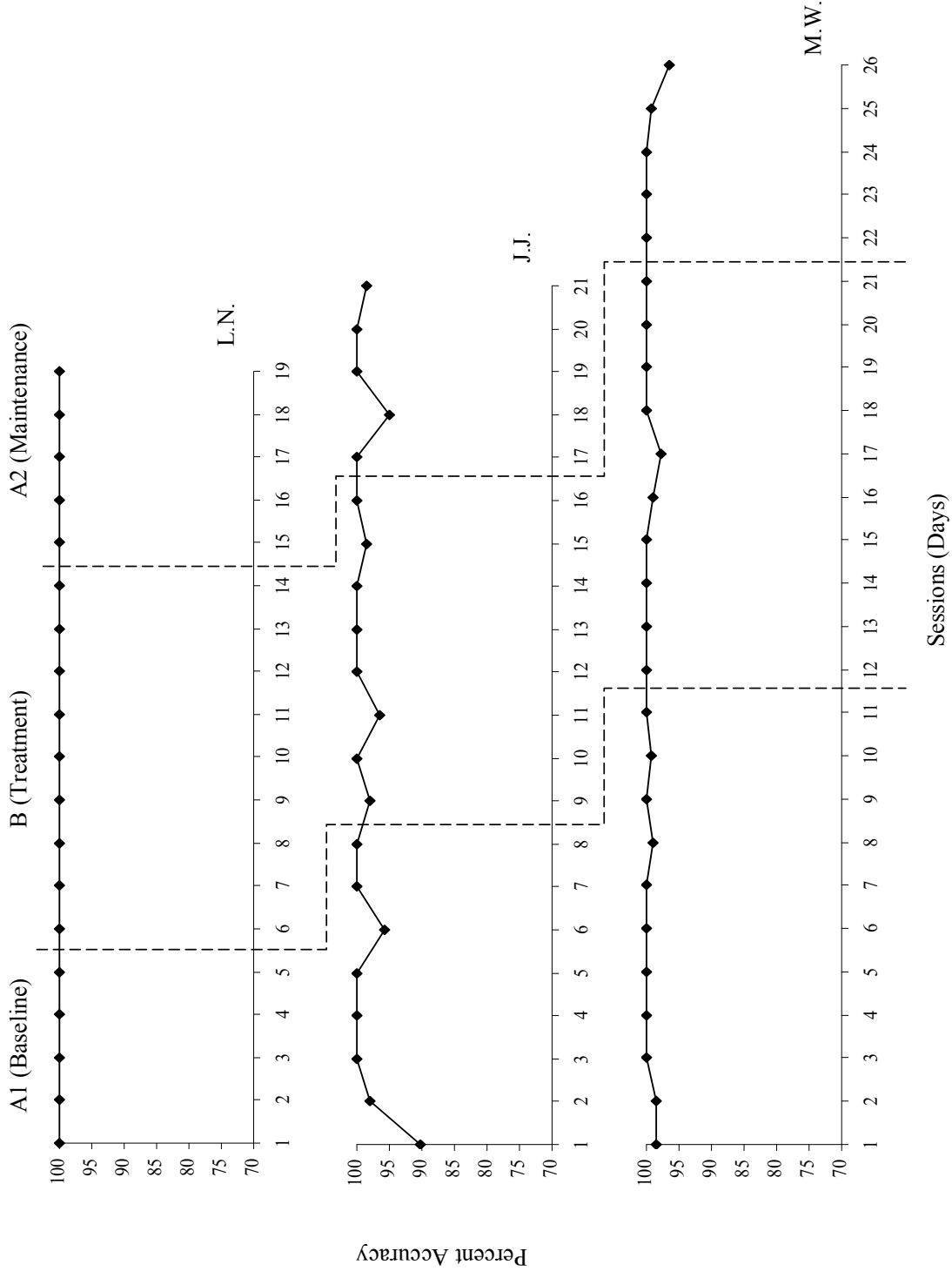


Figure E.1. Performance accuracy of the card sorting task for participants across phases and sessions.

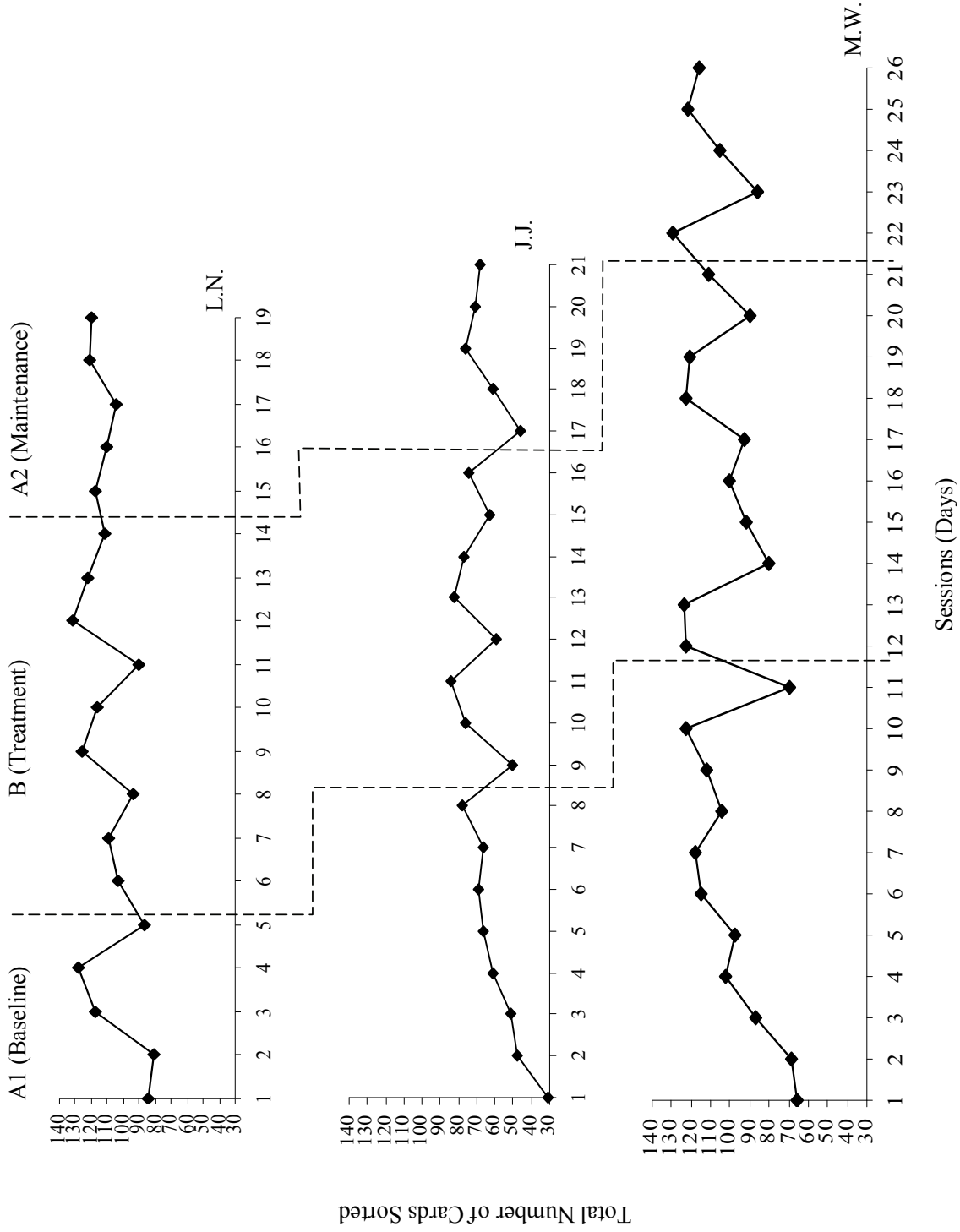


Figure E2. Total number of cards sorted for participants across phases and sessions.

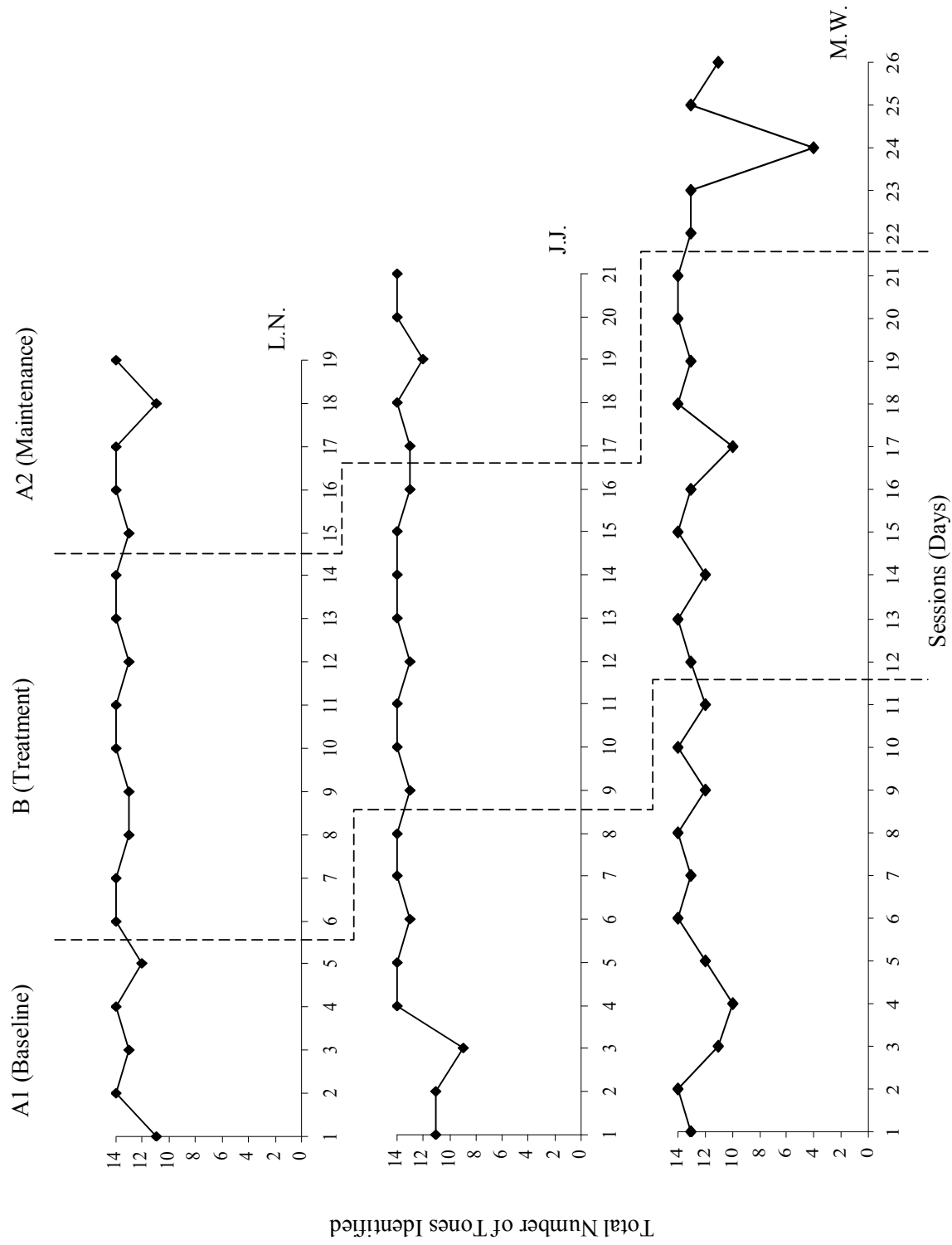


Figure E3. Performance accuracy of the target tone identification task for participants across phases and sessions.

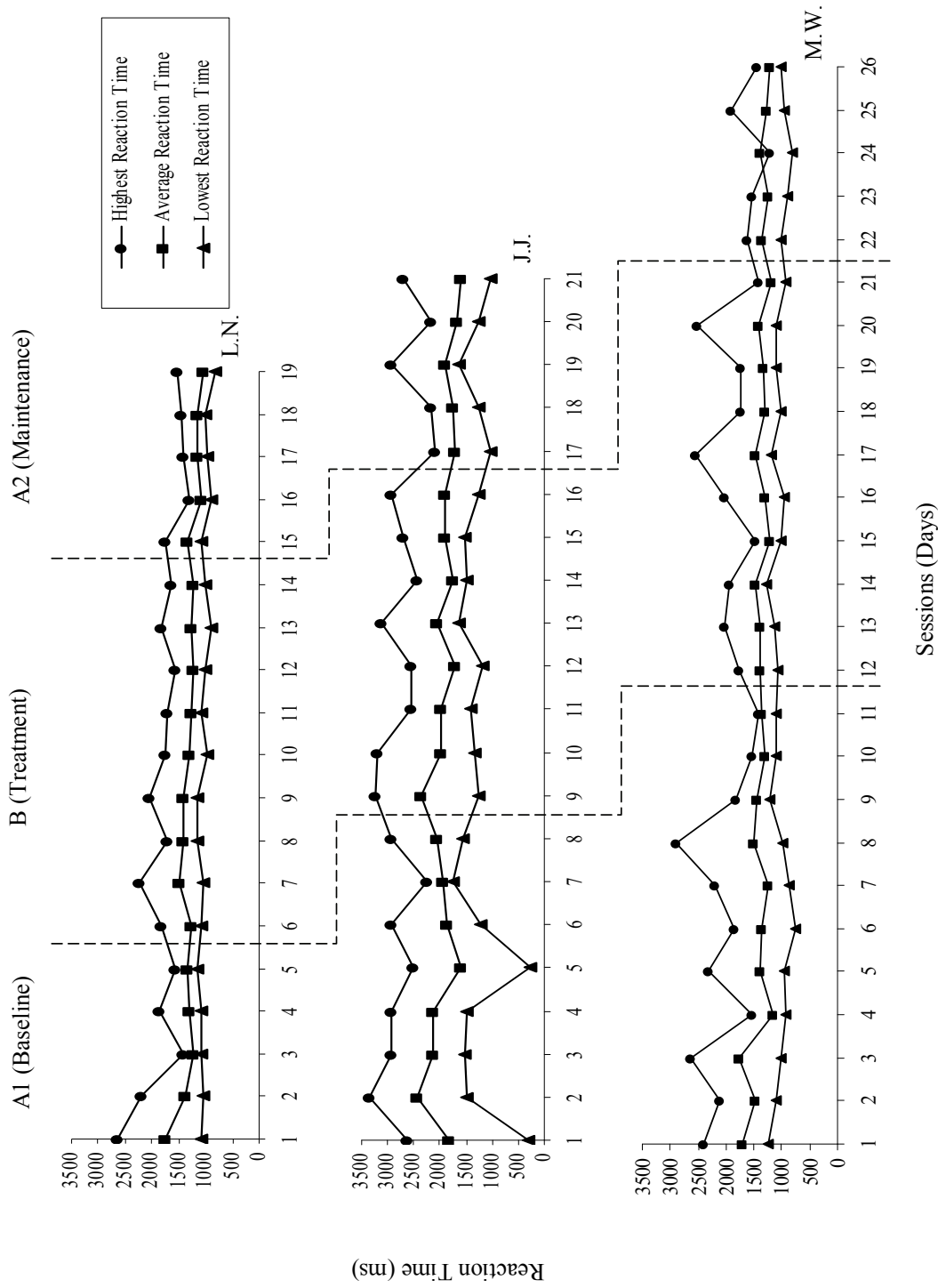


Figure E-4. Reaction times for the target tone identification task for participants across phases and sessions.

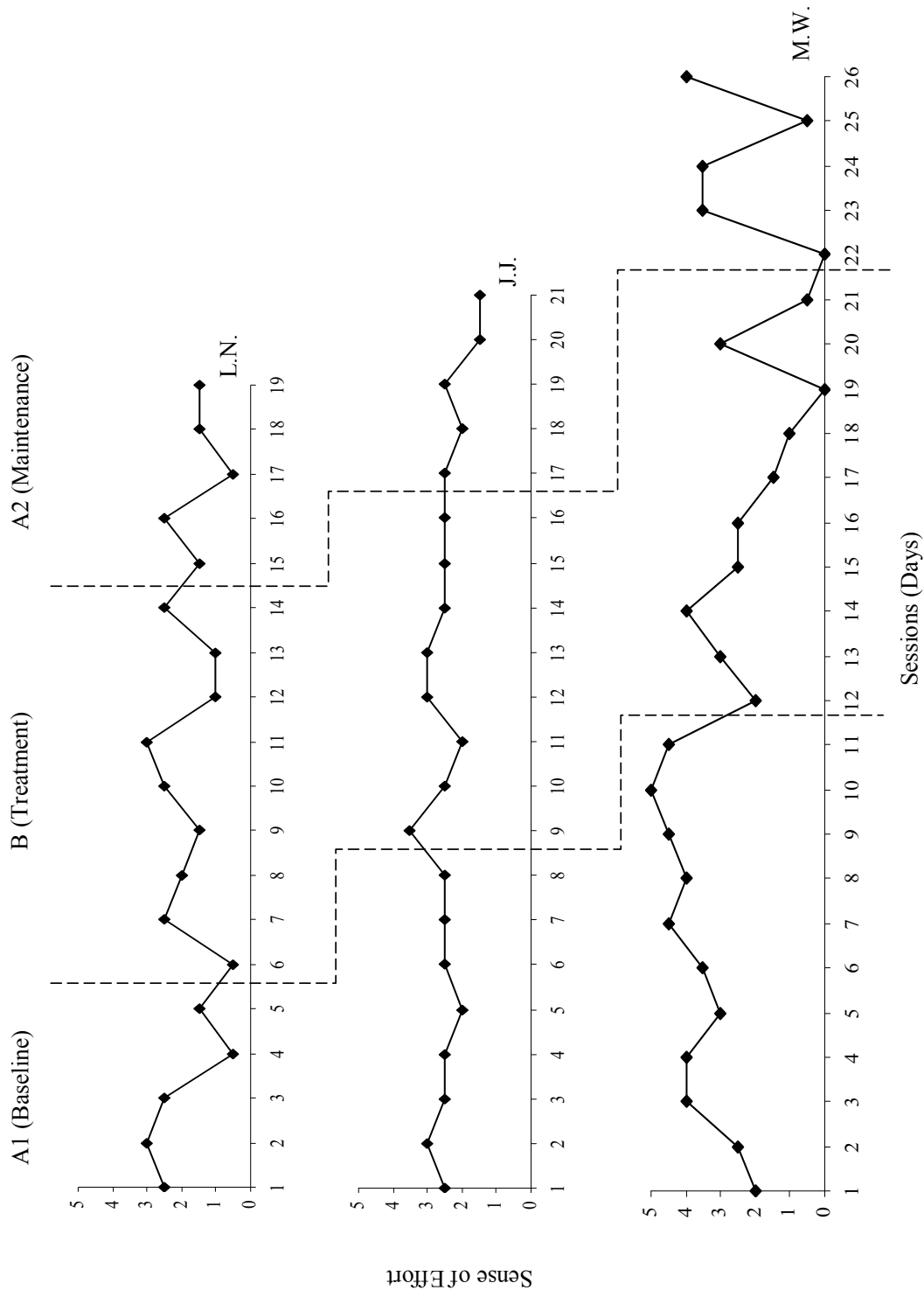


Figure E5. Sense of effort ratings for participants across phases and sessions.

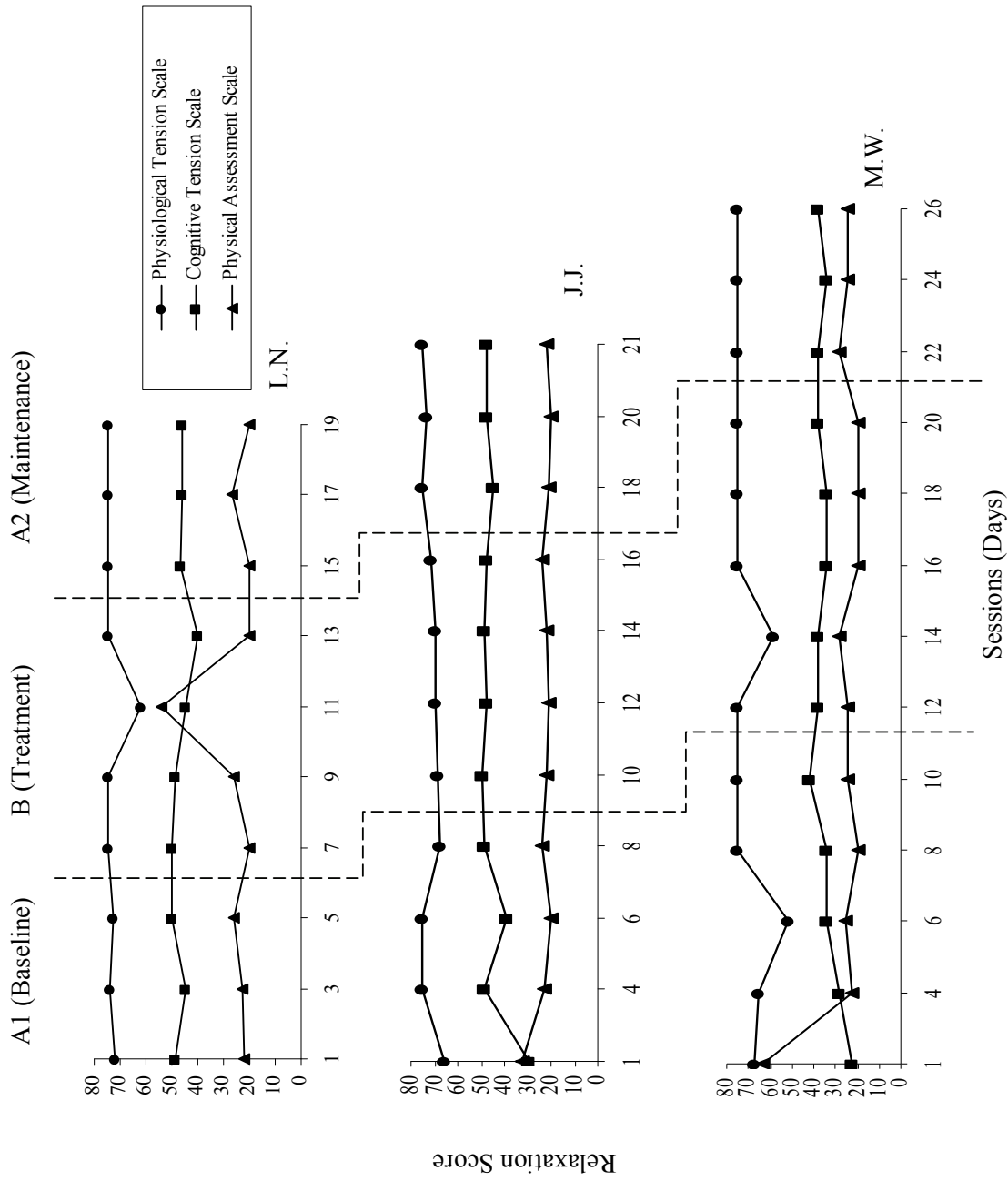


Figure E6. Relaxation Inventory scores for participants across phases and sessions