Reaction time procedures have been reported in the literature as potentially assisting in determining the presence of subtle differences in cognitive-linguistic processing following a mild traumatic brain injury due to the on-line nature of the task (Barrow, Hough, Rastatter, Walker, Holbert, & Rotondo, 2003; Collins & Long, 1996). While previous research demonstrates deficiencies in latency and accuracy of speeded tasks, the time-course or progression in which performance may return to pre-injury levels has not been examined. Additionally, many common environmental situations require rapid processing for both simple and complex cognitive-linguistic tasks in distracting conditions. Based on the reported literature, it is reasonable to expect that performance in these situations could be compromised in the MTBI population. Therefore, this study was designed to investigate three hypotheses: 1.) significant differences in response latency and accuracy will be found between the MTBI and control groups beyond the initial testing interval, 2.) significant differences in complex processing will persist beyond the resolution of simple processing and 3.) the presence of a common auditory distraction will differentially impact performance of the MTBI group.

Fourteen adults (ages 18-53) treated for a MTBI and 14 age and education-matched controls were asked to perform 2 speeded cognitive-linguistic tasks (simple and complex). The simple task involved confrontation naming and the complex task involved within category naming. The stimuli consisted of 72 line drawings equally balanced across three levels of age of acquisition and two category types. A body of research exists indicating that picture-vocabulary age of acquisition (Barrow et al, 2004; Cycowicz, Friedman, Rothstein, et al.1997; Dell & O'Seaghdha, 1992; Ellis & Morrison, 1998; Glaser, 1992; Humphreys & Riddoch, 1987; Martin, Weisburg & Saffran, 1989; Morrison, Ellis & Quinlan, 1992; Snodgrass & Yuditsky T, 1996) and the category in which the picture belongs (Gerlach, Law, Gade, et al., 1999; Lloyd-Jones & Humphreys, 1997a; Lloyd-Jones & Humphreys, 1997b; Martin, Wiggs, Ungerleider, et al., 1996; Perani, Schnur, Tettamanti, et al., 1999; Vitkovitch, Humphreys & Lloyd-Jones, 1993) influences latency and accuracy of a verbal response. Both tasks were presented with or without the presence a of common auditory distraction. The MTBI group was tested within 5 days, 30 days, 60 days, and 6 months post injury. Latency (ms) and accuracy of response were recorded.

Mean reaction time values for response latency for both the simple and complex tasks at each testing interval are presented in Table 1. Initially, the MTBI group demonstrated significantly longer response latencies for both the simple and complex tasks. As demonstrated in Figures 1 and 2, the difference in response latency between the groups increased as the vocabulary level increased. Similar results were found at 30 days post injury. At 60 days post injury, significant differences remained for both task 1 and task 2 latencies. At 6 months post injury, no significant differences were found.

Mean percentage of response accuracy for both the simple and complex tasks for each testing interval are presented in Table 2. As depicted in Figures 3 and 4, as the picture vocabulary level increased, the MTBI group displayed significantly less accurate responses for both the simple and complex tasks respectively. The presence of an auditory distraction differentially affected the MTBI group for task 2 accuracy upon initial testing and at 30 days post injury only. At 60 days post injury, the simple task revealed no differences while the complex task data revealed a significant difference. At six months post injury no significant differences were found

This study sought to examine both the time-course of recovery for speeded reaction time tasks and the influence of a common auditory distraction on cognitive-linguistic performance following a MTBI. In order to examine performance over time, participants were scheduled to complete the experimental protocol at the intervals of within 5 days of the injury, 30 days, 60 days, 6 months, and 1-year post injury. However, due to the results obtained at the 6-month interval, the 1-year follow-up appointment was eliminated. The speeded reaction time tasks involved two levels of language processing (simple and complex) under two conditions (no distraction and distraction present).

During the initial assessment, the MTBI group displayed significantly slower response latencies for both the simple and complex tasks overall without any differential influence of the presence of an auditory distraction. For both tasks, as the picture vocabulary level increased, the MTBI group became significantly slower to respond. This pattern of performance persisted at 30 days post injury, but began to show resolution at 60 days post injury. At the 60 day interval, the MTBI group continued to demonstrate slowed performance, but was no longer differentially influenced by the vocabulary level of the picture for the simple task. This finding implies that the MTBI group had recovered the manner in which simple processing occurred even though performance remained slower. However, the picture vocabulary level continued to affect performance for the complex task. Therefore, the efficiency at which processing can be accomplished appears to recover on a continuum according to the difficulty of the task. At 6 months post injury, the MTBI group no longer demonstrated any significant differences in the speed at which a response was given for either task.

Similar to the latency data, during the initial assessment interval the MTBI group demonstrated significantly less accuracy for both tasks. However, the influence of the variables of vocabulary level and the presence of the auditory distraction influenced accuracy of performance differently than the results found for response latency. At the initial testing interval, the MTBI group was differentially affected by the picture vocabulary level for the simple task, but not for the complex task. During the simple task, accuracy declined as the picture vocabulary level increased. However, during the complex task, accuracy of performance was significantly depressed regardless of the vocabulary level. It is hypothesized that the level of difficulty of the complex task at this early phase of recovery was so great that it depressed performance regardless of the level of the vocabulary. In addition, the presence of an auditory distraction further impacted performance of the MTBI group for the complex task, but not for the simple task. Thus, when the demand for language processing was greater, the MTBI group demonstrated significant difficulty with filtering out the auditory distraction in order to accurately complete the task. These findings support previous research indicating that dual-task performance is compromised following a MTBI (Brooks, Fos, Greve, et al., 1999; Stuss, Stethem, Hugenholtz, et al., 1989; Cicerone, 1996; Zahn & Mirsky, 1999).

This study demonstrated that difficulties with latency and accuracy of response for both simple and complex language processing persisted beyond the acute phase of recovery from a MTBI, began to resolve at 60 days post injury and were no longer evident at 6 months post injury. The recovery process over this time-course appears to resolve on a continuum depending on the difficulty level of the task with recovery of complex processing requiring a longer recovery time. In addition, the presence of an auditory distraction only influenced complex processing during the early stages of

recovery but dissipated before overall difficulties with complex processing resolved. This finding suggests that reduced processing accuracy may be caused by something other than deficits in divided attention in the later stages of recovery.

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Table 1. Mean response latencies (ms) for both naming and within category tasks according to the presence or absence of a distraction for each testing interval are presented.

Testing Interval	MTBI Group	Control Group
Initial Testing		
Simple Task	1010*	836
Complex Task	2231*	1724
30 Days Post Injury		
Simple Task	994*	
Complex Task	2020*	
60 Days Post Injury		
Simple Task	924*	749+
Complex Task	1975*	1659+
6 Months Post Injury		
Simple Task	790	
Complex Task	1706	

+ The control group was adjusted to maintain age and education matching with the reduced number of MTBI participants at the 60 day and 6 month intervals.

* Indicates $p < .05$

Table 2. Mean percentage of response accuracy for both naming and within category tasks for each testing interval.

Testing Interval	MTBI Group	Control Group
Initial Testing		
Naming Task	85*	95
Within Category Task	67*	88
30 Days Post Injury		
Naming Task	89*	
Within Category Task	68*	
60 Days Post Injury		
Naming Task	93	95+
Within Category Task	67*	79+
6 Months Post Injury		
Naming Task	94	
Within Category Task	77	

+ The control group was adjusted to maintain age and education matching with the reduced number of MTBI participants at the 60 day and 6 month intervals.

* Indicates $p < .05$

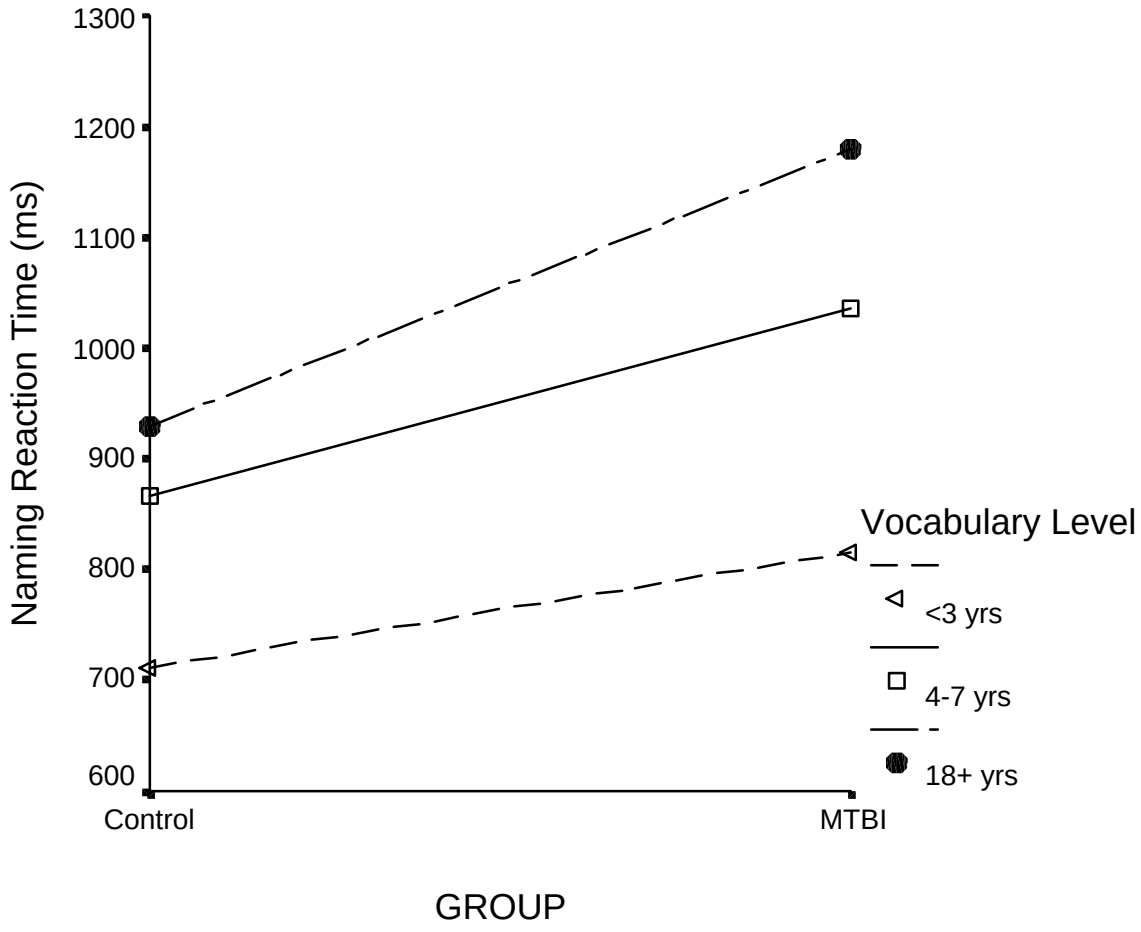

Figure 1. Latency (ms) as a function of group and picture-vocabulary level for the simple task at the initial testing interval.

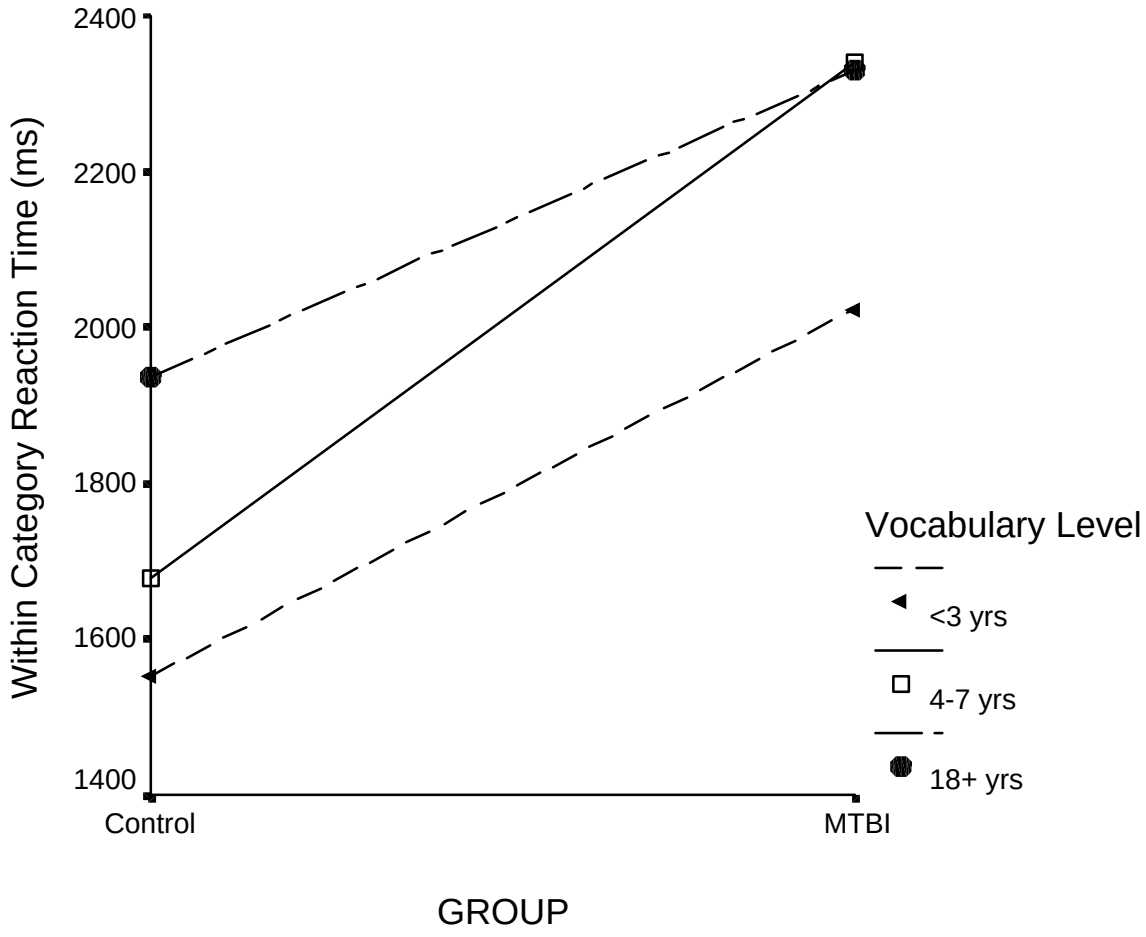

Figure 2. Latency (ms) as a function of group and picture-vocabulary level for the complex task at the initial testing interval.

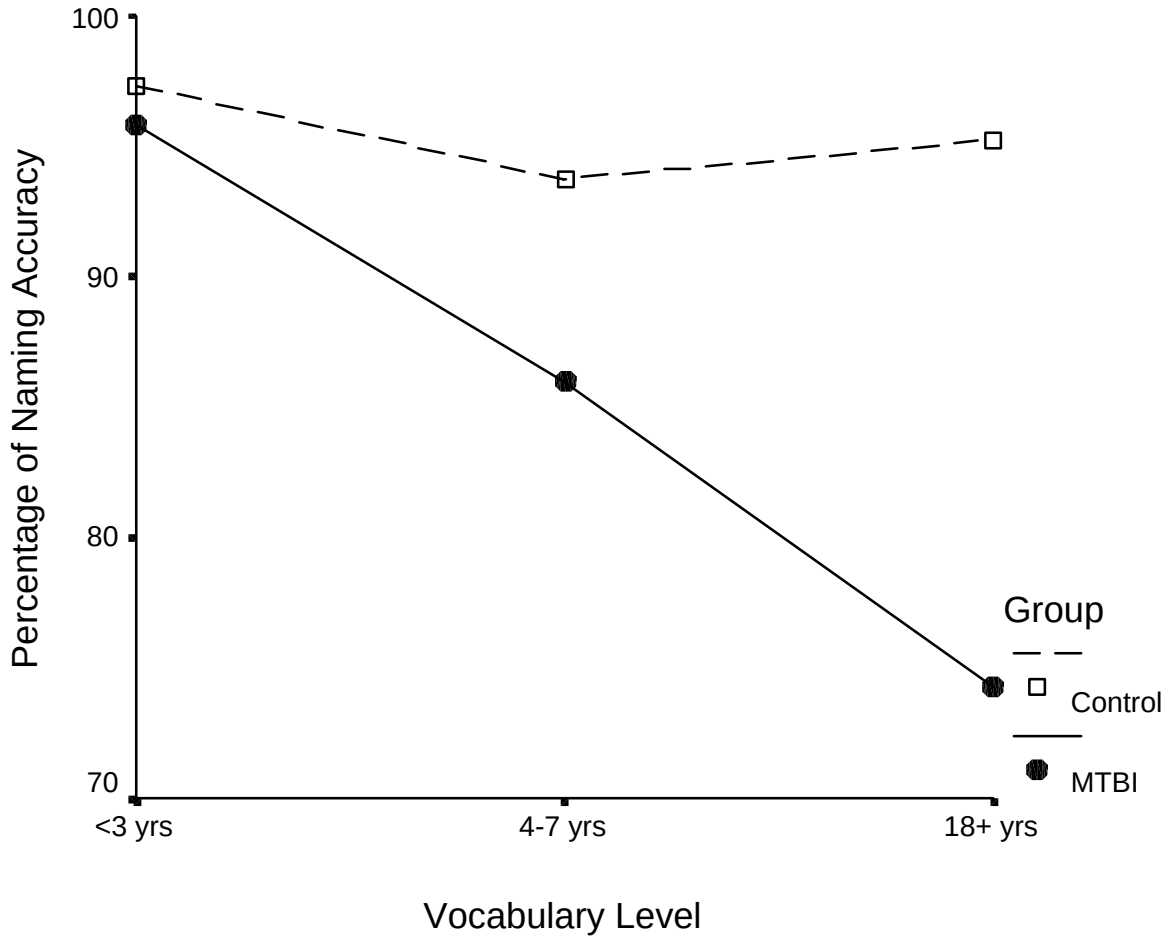

Figure 3. Percentage of response accuracy as a function of group and vocabulary level for the simple task at the initial testing interval.

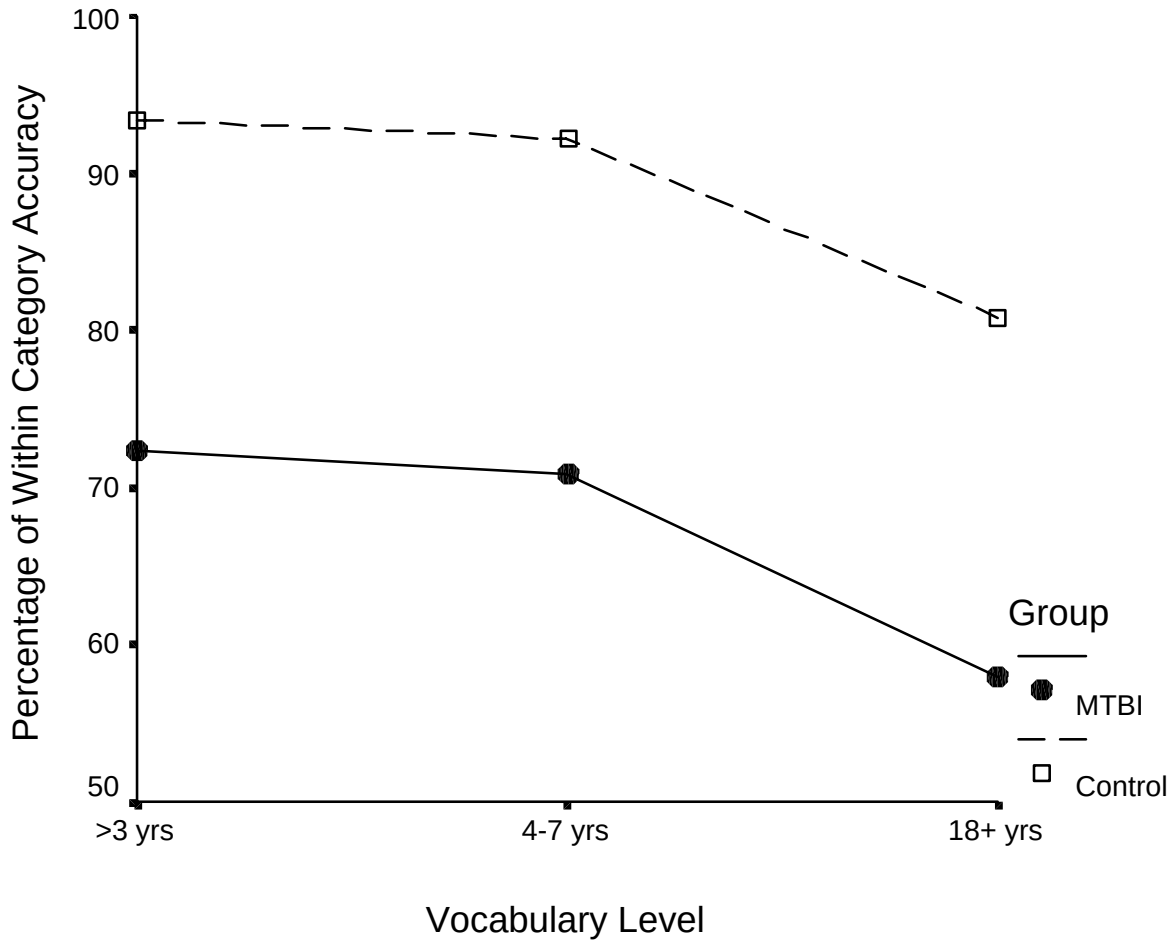

Figure 4. Percentage of response accuracy as a function of group and vocabulary level for complex processing at the initial testing interval.