

PREDICTING COGNITIVE PERFORMANCE FROM AWARENESS MEASURES IN  
INDIVIDUALS WITH ACQUIRED BRAIN INJURY

By

Kayla Long

A thesis presented to the faculty of

Towson University

In partial fulfillment

of the requirements for the degree

Master of Science

Department of Experimental Psychology

Towson University

Towson, Maryland 21252

(May, 2017)

EXPERIMENTAL PSYCHOLOGY PROGRAM

THESIS PROPOSAL APPROVAL FORM

This form indicates that the thesis chair and committee members have approved a thesis proposal

This form is to be completed after the thesis proposal meeting. If major revisions are needed, committee chair and members should not sign this form until the revisions have been completed.

Student's Name Kayla Long

Date of Thesis Proposal Meeting 4/28/17

Chair, Thesis Committee [Signature] Bryan Dolan  
Signature Print name

Member, Thesis Committee [Signature] Rick Parents  
Signature Print name  
4/28/17

Member, Thesis Committee [Signature] Mark Chachick  
Signature Print name

Member, Thesis Committee [Signature] 5-10-17  
Signature Print name

### Abstract

Anosognosia refers to lack of awareness of cognitive and executive deficits. It is a commonly reported problem after acquired brain injury (ABI) or stroke and often hinders an individual's ability to modify their behavior and to function in social situations or at work. This study concerned the question of whether the level of anosognosia after ABI predicts cognitive performance on standardized neuropsychological tests. It was hypothesized that lack awareness of cognitive deficits would be inversely related to performance on measures of cognitive performance. Archival data consisting of patient and observer ratings were derived from the Cognitive Complaints Survey (CCS), a 36-item survey providing both patient self-report and an observer assessment of awareness. The scoring procedure for this test provided two discrepancy scores that assessed: deficit with awareness (DWA) and deficit without awareness (DWOA). The discrepancy scores were correlated with IQ scores measured from the Wechsler Adult Intelligence Scale, the Wechsler Memory Scale, and a measure of finger tapping speed. Results indicated that the DWOA measure did correlate significantly with finger tapping speed and a measure of non-verbal working memory. The DWA measure did not correlate with any of the performance measures.

## Table of Contents

List of Figures	v
Introduction	1 – 8
Awareness defined	1
When one is not aware	2
Theories of deficit awareness	2 – 3
Assessing awareness	3 – 6
Implications for therapy	6 – 7
Present Study	7 – 8
Method	8 – 11
Participants	8
Measures	8 – 11
Results	12 – 14
Discussion	15 – 18
References	18 – 21
CV	22

## LIST OF FIGURES

Figures		Page
i.	Figure 1 Predicted by observed.....	12
ii.	Figure 2 Coefficient relationship.....	13
iii.	Table 1 Coefficient significance.....	14
ix.	Figure 3 Importance values.....	14

## **Introduction**

Anosognosia, is the lack of awareness characterized by failure to recognize personal deficits. This type of deficit is commonly reported after brain injury or stroke. Symptoms of Anosognosia include discrepancies between an ABI survivor's perception of their functioning relative to observations of close family members, friends, and clinicians who work with them. These perceptions are usually derived from ratings of cognitive and behavioral deficits which indicate that the survivor is less aware of their deficits relative to the observers (Cheney & Parente, 2016; English, St. Pierre, Cheney, Delehay, & Parente, 2016; Leathem, Murphy, & Flett, 1998; Sandhaug, Andelic, Berntsen, Seiler, & Mygland, 2012). All of these studies suggest that ABI survivors may not be able to modify their behavior until they first become aware of their cognitive deficits (Giacino, Joseph, Cicerone, & Keith, 1998). The purpose of this study was to further research the presence and pertinence of awareness in patients with brain injury. Building off research done by Long, Reger, and Adams (2013) this study used similar methods to test the validity of past results and to control for some of the limitations.

### **Awareness defined**

Toglia and Kirk (2002) indicated that awareness of deficits affects three different areas of life: cognitive, psychosocial, and psychological. The state of being aware means to understand the impact and limitations of one's personal skills or abilities within each of these three domains. Awareness affects our ability to think, comprehend, remember, interact socially, and to maintain emotional stability. These authors suggest that awareness has two components. The first, intellectual awareness or "metacognition," is the ability to understand one's strengths, weaknesses and limitations. The second is anticipatory/emergent or "real-time" awareness, which involves self-monitoring and self-correction of errors during task performance.

**When one is not aware**

Deficit Awareness is the ability to acknowledge one's restrictions and modify behavior to limit cognitive and social errors and to reduce psychological stress. Most people with brain injury overestimate, i.e., Hyperawareness, or underestimate, i.e., Hypoawareness, their behavioral competence (Prigatano, 1999). Anosognosia is a general term that can be used to describe hypo or hyper-awareness in individuals with an ABI. The best way to define this condition is through its Greek derivative, *gnos* meaning disease, *gnosis*, meaning knowledge, and *an* as a negative prefix. (Prigatano, 1991). However, Anosognosia is not generally accepted as the main cause for awareness deficit in patients with an acquired brain injury. Multiple theories for understanding the underlying cause of awareness deficits include the Lesion theory, general disorder theory, and psychological denial (Sandhaug et. al, 2012).

**Theories of deficit awareness**

The lesion theory suggests that focal lesions in the brain underlie awareness deficit. However, this theory does not necessarily explain behavioral and personality changes that these focal lesions might cause (Onsworth, McFarland, & Young, 2002). General disorder theory suggests that disruption in only higher order thinking affects awareness (Onsworth, McFarland, & Young, 2002). It is, however, unclear what higher order thinking entails and which aspects of higher order thinking are correlated with deficit awareness. Psychological denial theory suggests that ABI survivors are aware of their deficits but deny them. This theory was supported by the family members' descriptions of patients with ABI. Specifically, ABI survivors who showed a tendency to underestimate their limitations were reported in a 7-year follow-up by relatives as "refusing" to admit difficulties. The relatives' descriptions raise the question of whether TBI patients are unaware of their abilities or if they simply deny their difficulties (Oddy, Coughlan, Tyerman, & Jenkins, 1985, Prigatano, 1991).

Allen and Ruff (1990) suggested that the accuracy of self-reporting depends on three levels of processing; awareness, appraisal, and disclosure. Awareness is the process of discovering, encoding, and retrieving information about yourself. Appraisal is the ability to compare the survivor's current cognitive state to their cognitive state pre-injury (Ownsworth McFarland, Young, 2002). Disclosure, involves the ability to accurately describe one's self-perceptions to others. Localizing a patient's problems within the three levels of processing is essential when implementing therapy because deficits in any of these individual areas would presumably require equally individualized treatments.

Ownsworth, McFarland, and Young (2002) assessed awareness by correlating multiple standardized measures of self-awareness, self-regulation, IQ, executive function, and psychological factors such as personality-related denial collected from 61 ABI patients. These authors found that those who reported high levels of personality-related denial and impaired awareness performed worse on tests of intellectual skill. This result suggests a significant relationship between awareness of deficits and cognitive performance. The problem remains however, whether the relationship derives from lack of awareness or denial of deficit.

### **Assessing awareness**

Self/other discrepancies have been the primary means of assessing the presence, degree and type of awareness, (Murphy & Flett, 1998); however, these measures do not necessarily measure correlated attributes. Examples of awareness questionnaires in current use include the Patient Caregiver Rating Scale (PCRS) and the Awareness Questionnaire (AQ); each scale measures awareness in a unique way (Flashman & McAllister, 2002). Prigatano and colleagues (1990) developed the PCRS to assess activities of daily living (ADLs), cognitive functioning, interpersonal functioning and emotional regulation. The AQ was developed by Sherer and colleagues (1998) as an alternative to the PCRS and compares current functional abilities to pre-injury abilities.

The major difference between these two instruments is that the PCRS assesses the present, while the AQ measures the present in relation to the past.

Some authors have reported little discrepancy between self- and other-ratings and therefore little evidence of lack of awareness (Ezrachi, Ben-Yishay, & Kay, 1991; Lezak, 1989). For example, using the Neurobehavioral Functioning Inventory which assesses depression, somatic memory/attention, communication, aggression and motor symptoms, Seel and colleagues (1997) reported that mild to severe ABI survivors produced generally good self/other agreement; i.e., the majority of the sample produced low discrepancy scores on most of the scales. Conversely, Dywan and Segalowitz (1996) found that family members rated moderate to severe ABI patients' difficulties significantly higher than the same patients rated themselves. Likewise, Cohen and Swerdlick (2009) found large discrepancy ratings across all scales (i.e. planning, initiation, arousal/inhibition, and social monitoring) except for memory/attention. English, et al., (2016) found that there was no correlation among self-ratings of executive skill and observers' ratings of the same person. Moreover, she reported that patients' self-ratings did not correlate with how they thought others would rate them. This result suggests that persons with ABI are unaware of how others see them.

One possible cause for the discrepancies among these published results may come from differences in the type of measure used. Sherer and colleagues (2003) compared the AQ and PCRS measures with not only patient/family discrepancy scores but also patient/clinician scores. These discrepancies were calculated by subtracting the other-ratings from the self-ratings resulting in positive and negative scores. Negative scores, which occurred infrequently, indicated that a patient underestimated his or her performance. On the other hand, positive scores, which more commonly occurred, indicated that a patient overestimated his or her performance. Participants consisted of 129 ABI inpatients admitted into one of the two in-patient brain injury rehabilitation programs offered at

the Methodist Rehabilitation Centre and Moss Rehab (Ezrachi et al., 1991; Prigatano, 1999). Results indicated that the AQ and PCRS measures were moderately correlated and that patient/clinician scores showed more discrepancy relative to patient/family scores.

Modifications of existing questionnaire items have produced a variety of awareness questionnaires specific to types of cognition and personality. These scales better assess awareness of patients with different levels of injury severity, type, and recovery. For example, Borgaro and Prigatano (2003) developed an altered form of the PCRS to better assess patients during post-acute stages of recovery called the PCRS-neurorehabilitation (NR). This questionnaire focused on the details of injury type, stage, and severity in an attempt to better understand the diverse effects of brain injury. Most of these questionnaires, however, still rely on discrepancy scores between self and other perceptions.

Sherer and colleagues (2003) raised an important concern about ABI and awareness research regarding the validity of self/other rating discrepancies. The majority of research, and all of the studies previously mentioned have used discrepancy scores as a benchmark to assess awareness after ABI. However, the logic assumes that the “other” score is the more accurate of the two (Flashman & McAllister, 2002). The results from Sherer and colleagues (2003) suggest that the “other” scores collected from family members are more likely accurate because the patient/family scores assess daily observations of the survivor. However, other observer’s ratings may not be as useful as a family member’s. For example, a clinician who sees a patient once a week or once a month does not observe that patients’ behavior every day. The difference in exposure between a family member’s and a clinician’s observations may account for the low correlation between their ratings of the patient. In addition, removing the familial view of the patient may remove the real-life aspect to the study. Professionals are trained to identify issues with their patients but are not able to interact with them constantly.

Although observations from professionals may be accurate within the clinical setting, patients may act differently in a structured clinical setting than they do at home.

Although an observer's ratings of an ABI individual can be objective, some behaviors may be easier to assess than others. Abstractions such as feelings of frustration, clarity, boredom and confusion are difficult to scale and may change dramatically from day to day. Concrete behaviors, for example handwriting, walking, and math calculation, may be easier to quantify (Kreutzer & Sander, 1997). Anderson (1994) found that brain injured survivors' self-ratings of their concrete skills, such as their ability to ambulate, write and do math calculations, correlated well with actual measures of these skills (Smeets et al., 2012). Other-ratings of more abstract skills such as comprehension, vocabulary, memory and IQ correlated significantly with psychological test indices of these abilities (Cohen & Swerdlick, 2009; Sbordone, Seyranian, & Ruff, 1998).

### **Implications for Therapy**

The importance of being aware of changes in one's cognitive performance and personality is paramount in successfully adapting to a post-injury lifestyle (Flashman & McAllister, 2002). Clinicians working to rehabilitate TBI patients have suggested that lack of awareness inhibits long-term functional recovery, the eventual return to employment and a self-supporting lifestyle (Flashman & McAllister, 2002). Trudel, Tryon, and Purdum (1996) found that TBI individuals who demonstrated a lack of awareness performed poorly in several areas of independent behavior. Behavioral difficulties, lower vocational achievement, and lower independent living status are often displayed by those individuals who lack awareness. Sveen, Mong, Roe, Sandvik, and Bantz-Holter (2008) and these shortcomings may limit the person's ability to live independently.

Vocational outcomes, such as successfully returning to work, were also studied on a large scale by the New York University Head Trauma Program (Flashman & McAllister, 2002) in which awareness was a major predictor of a successful return to work

(Ezrachi et al., 1991; Rattok, Ben-Yishay, & Lakin, 1992). The more recent study by Sveen et al. (2008) replicated these findings. In this study the level of awareness predicted whether participants would return to work, and it predicted the amount of their community participation. Additionally, Prigatano and Altman (1990) demonstrated that patients who had completed a neuropsychologically oriented rehabilitation program produced similar awareness deficit ratings relative to staff who had worked with them for several months. However, patients who did not respond to treatment overestimated their daily activities skill relative to staff ratings. These combined results suggest that measures of awareness or lack of awareness may predict successful therapy and successful return to work.

Prigatano (1999) tested patients with significant awareness deficits with a Halstead finger tapping test and showed slower speeds for their left hand. This study resulted in the correlation between the speed of the non-afflicted hand and achieving rehabilitation goals. Heaton and colleagues (1978) reported that those who had faster speeds were more likely employed in both full-time and part-time positions. However, it is unclear if finger tapping speed is correlated with anosognosia or if it is simply a measure of motor skill which is correlated with successful return to work. Promising results reported in 2008, by Prigatano, Gray, and Legacy, indicated that severity of an ABI in children predicted measures of perceptual organization and processing speed.

### **The present study**

Long, Reger, and Adams (2014) used archival data from learning disabled and brain injured persons, to answer the question of whether awareness discrepancy scores predict cognitive performance for patients with ABI. These authors found that the discrepancy scores for the LD and ABI groups did not differ significantly, however the ABI group showed slightly elevated scores on measures of lack of awareness.

Significant relationships between lack of awareness and cognitive performances included finger tapping speed (non-dominant hand), working memory, processing speed, and auditory memory. However, these relationships were correlational and require replication. Given the previous results, it was hypothesized that the level of awareness for ABI survivors in this study would correlate significantly with measures of cognitive performance. Specifically, measures of awareness will correlate with finger tapping speed and various measures of cognition. Although this prediction follows from the existing literature outlined above, it is unclear whether measures of awareness versus lack of awareness will correlate differentially with these cognitive measures. Therefore, the present study will construct two different types of awareness measures: the first measures the patients' awareness of their deficit areas. The second, measures their lack of awareness of the same areas. The hypothesis being tested concerns whether one or both of these measures correlates with the above-mentioned measures of cognitive functioning.

## **Method**

### **Participants**

The study sample included a total of 62 participants. Of the 62 participants 14 individuals had a history of brain injury and 17 individuals were diagnosed with a learning disability. The other 31 participants included the "observers" of the participants who represented their family members and friends. Individuals considered as observers interacted with the clients on a daily basis.

### **Measures**

Each of the patients and observers filled out a version of the Cognitive Complaints Survey (ACCS) (Parente, Rager, & Adams, 2012); the patients were evaluated with measures of intellectual cognitive performance.

Approximately half of the patients in this study had been diagnosed with ABI whereas the remainder had been diagnosed with a learning disability without any report of a pre-existing brain injury or neurological dysfunction.

The data consisted of ratings from psychological evaluations completed as part of an assessment for private referrals. Each evaluation was completed individually by a licensed psychologist and administration of the ACCS was the last task in the evaluation, i.e., after all the other tests had been completed. The ACCS was used to compute measures of lack of awareness.

The ACCS is a 36-item survey that measures reported cognitive symptom ‘complaints’ in nine categories: Attention, Expressive/Receptive Language, Executive, Hyperactivity, Learning, Memory, Processing, Social Skills and Vigilance. Fifty items were generated from the self-report of over 100 persons with brain injury (Parente & Herrmann, 2010). These patients were asked to describe “their biggest problem” since their injury. The 50 items with the greatest frequency were compiled over a 23-year period with each item having multiple references by at least three independent survivors. The authors grouped these items into the above categories. The content validity of the ACCS items was established with 30 college student participants who rated each of the items for its association with the above categories. Content validity coefficients were then computed on each item according to procedures outlined by Cohen & Swerdlick, (2009).

A total of 36 items with significant content validity were then administered to a separate sample of 70 college students and coefficient alpha was computed for each of the sub-scale categories. Items were selected for the various categories according to three criteria. First, each selected item had significant content validity as outlined above. Second, each selected item had a significant item/scale correlation with the category to which it was assigned. Finally, each sub-scale had significant internal consistency (i.e., coefficient alpha ranging from .66-.88).

The final questionnaire contained 36 items and this reduced instrument became the ACCS which was used in two forms, a client and an observer version. The only difference between the two survey types is that the items on the client version all begin with “I” statements (e.g., I am unable to think clearly...), whereas the observer version items did not.

The primary use of the ACCS has been to determine the extent of cognitive deficit and to assess deficit awareness for persons with brain injury and learning disability. It is typically administered to the client at the end of a psychological evaluation whereas the observer also provides his or her ratings independent of the client. Those items on which the client and the observer agree are considered to be the best estimates of the client’s everyday cognitive deficits. It is therefore possible to compare the client ratings to the observer ratings to assess the extent to which the client either over or underestimates his or her deficits.

The instrument can also be used to assess the client’s awareness. Measures of deficit awareness derive from the differences in self-ratings for the client versus the observer ratings. Deficit with Awareness (DwA) is the percent of the items where the client and observer agree that there is a problem and the two ratings are approximately the same. Deficit without awareness (DWOA) is the percent of items where the patient feels there is no deficit but the observer indicates that there is one. These two measures were computed after the client and observer had filled out their individual versions of the ACCS. Therefore, each participant had two measures. One measure was an index of their awareness of perceived deficit whereas the other measure index their lack of awareness. In addition, each participant was administered a complete battery of psychological tests which included measures of intellectual and memory functioning along with tests of finger tapping speed on the dominant and nondominant hand.

Each participant was administered a psychological battery of tests that included several different measures of cognitive, academic, and motor functioning: Wechsler Adult Intelligence Scale scores on four major subtests (Verbal Comprehension, Perceptual Organization, Working Memory and Processing Speed), measures of academic skill (Reading, Math and Writing) from the Woodcock-Johnson Psychoeducational Battery, and Memory (Verbal, Auditory, Immediate and Delayed Memory) scores from the Wechsler Memory Scale and a measure of Finger Tapping Speed taken from both the dominant and non-dominant hand. All of the measures were collected from the ABI clients however, the finger tapping test data was not collected from the LD participants. Therefore, the correlational analyses below that included finger tapping speed were computed on only those that came from the ABI survivors. Correlations for the other measure of memory and intellectual functioning were computed on all of the participants' data.

### **Results**

Multiple linear regression modeling was used to assess the relationships between the various cognitive measures and the measures of awareness and lack of awareness that were constructed from the questionnaires filled out by the patients in their family members. The cognitive measures included: verbal IQ, performance IQ, working memory, processing speed, and full scale IQ. In addition, measures of verbal memory, nonverbal memory, visual working memory, immediate memory, and delayed memory were also included in the regression. A measure of finger tapping speed on both the dominant and non-dominant hand were also included.

Figure 1 below is a plot of the predicted and observed scores for the deficit without awareness measure. The plot indicates a significant multiple correlation squared correlation of .31,  $F(2,29) = 7.49$ ,  $p < .05$ .

Figure 2 expresses this relationship in greater detail. The yellow lines connecting the predictors to the outcome score indicate an inverse relationship between these two measures in the outcome variable. Specifically, as lack of awareness increased, finger tapping speed and visual working memory decreased. Table 1 below indicates that both predictor variables were significant ( $p < .05$ ) and that visual working memory was the better of the two predictor variables as evidenced by the larger weights and importance value. Figure 3 below is a visual display of the important values associated with each predictor. The same analysis performed on the DWA variable did not yield any significant results.

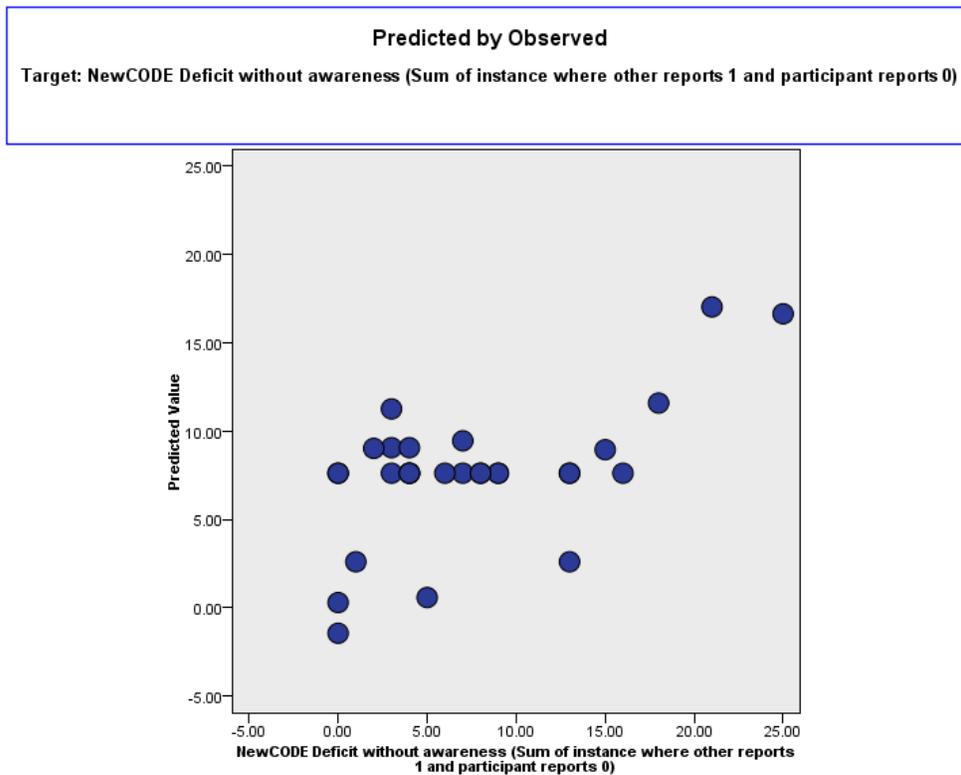


Figure 1 Predicted by observed. Significant multiple correlation squared correlation of .31,  $F(2,29) =$

7.49,  $p < .05$ .

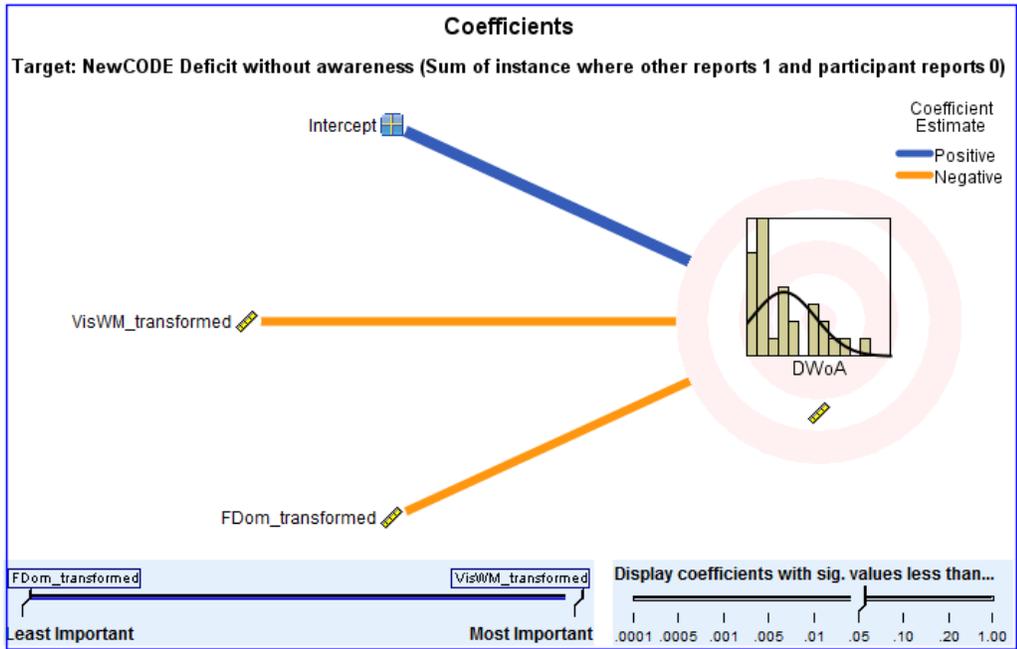


Figure 2 Coefficient relationship. The orange line represents a negative correlation between the observed variable, deficit without awareness (DWoA), and the predicted variables; visual working memory and finger tapping speed of the dominate hand.



### **Discussion**

The objective of this study was to assess the relationship between deficit with and without awareness, and cognitive performance in patients with a history of brain injury. The purpose of this research was to build upon the results of past research showing a significant inverse relationship between lack of awareness and cognitive performance scores among a sample of patients with an ABI. The methods used in the present study were patterned after research done by Long, Reger, and Adam (2014) and included the same source of archival data. Some of the data for the participants used in the Long, Reger, and Adam (2014) study were used in the current study with the addition to 20 more participants. In total, 29 complete cases comprise the data set used in the present analyses.

The Long, Reger, and Adam (2014) study was one of few to find a significant relationship between lack of awareness and decreased finger tapping speed in the non-dominant hand. While other studies have a similar relationship between lack of awareness and decreased finger tapping speed score in both hands (Prigatano, 1999), it was hypothesized by Long, Reger, and Adam (2014) that the non-dominant hand could have been more affected by a lack of awareness because the dominant hand movements are more automatic and require less attention. The Long, Reger, and Adam (2014) study was the first to find significant inverse relationships between a lack of awareness and working memory, processing speed, and auditory memory. Validation of this relationship would suggest that those with a lack of awareness would have difficulty manipulating and processing novel information in working memory. Success in school, job training, and other tasks that require memory, rapid finger dexterity, and processing speed could be affected negatively by an individual who is not aware of their deficits. However, the present study suggests that some of these correlative relationships may be unstable.

The present study replicated some of the findings of the earlier Long, Reger, and Adam (2014) investigation but not all of them. Finger tapping speed on the nondominant hand did predict the lack of awareness measure. A measure of visual working memory likewise predicted lack of awareness. The predictive relationship between these two cognitive measures and lack of awareness was in the predicted direction. Specifically, as lack of awareness increased, finger tapping speed and visual working memory decreased.

Visual working memory is one component of the overall working memory system. The central executive is responsible for allocating attention to relevant information (Baddeley, 2000). The visual and auditory systems maintain information from audio, visual, and spatial stimuli (Baddeley, 2000). The working memory system also includes an episodic buffer which integrates the incoming information into a unitary episodic representation which is consolidated into long-term memory. (Baddeley, 2000). The visual working memory and visual – spatial sketchpad serve a common purpose. These results suggest that damage to the visual working memory can also affect how information is encoded and, more importantly, what information is encoded. For example, it may be difficult for an ABI survivor to process visual images of his or her behavior or assess the effect it has on others and to store away these images in a way that can be processed and retrieved effectively.

Finger tapping speed is often used as a measure of prefrontal functioning. Because the relationship between finger tapping speed on the nondominant hand and lack of awareness was negative suggests that prefrontal functioning is inversely related to lack of awareness. Because prefrontal functioning is also related to other executive skills such as planning, organizing, prioritizing, it is likely that limitations in the prefrontal area inhibit the ABI survivor's ability to allocate processing.

Although this study was not designed to compare ABI survivors to those with learning disabilities, it is interesting to note that there were no significant differences between these two groups on the measures obtained here. This suggests that persons with learning disabilities may suffer similar deficits and lack of awareness as to those with ABI. There are several limitations to this study that should be considered before any firm conclusions can be drawn. First, although these results replicated the results of earlier studies, there is no guarantee that the patient populations were the same or the family dynamics were comparable. It is also the case that this study included 29 complete cases and would still be considered a small sample size. The study did not include any specific measures of attention and concentration which have been identified in previous studies to also correlate with measures of awareness. The measures of deficit with and without awareness used here are novel and there is little literature that has investigated their efficacy. Despite these issues, the replicated results of this in the earlier Long, Reger, and Adam (2014) study are encouraging and provide promising avenues for additional research.

Future research should focus not only on the relationship between finger tapping speed and lack of awareness but more so, on measures of frontal lobe functioning as predictors of awareness measures. Other measures of visual working memory should also be investigated such as measures of spatial reasoning, visual processing speed, and a wider variety of visual mental control measures. It is also important to include a comprehensive battery of attention and concentration measures as predictors of awareness. Another useful avenue would be to develop additional measures of lack of awareness using other observational tools.

### References

- Allen, C. & Ruff, R. (1990). Self-rating versus neurophysiological performance of moderate versus severe head-injured patients. *Brain Injury*, 7 (17), 1990.
- Baddeley, A. (2000). The episodic buffer: a new component of working memory? *Trends cognitive science*, 4, 417-423.
- Borgaro, S., & Prigatano, G. (2003). Modification of the Patient Competency Rating Scale for use on an acute neurorehabilitation unit: The PCRS-NR. *Brain injury*, 17 (10), 847-853.
- Carlozzi, N., Grech J., & Tulskey, D. (2013). Memory functioning in individuals with traumatic brain injury: An examination of the Wechsler Memory Scale-Fourth Edition (WMS-IV). *Journal of Clinical and Experimental Neuropsychology*, 35(9), 906-914.
- Cohen, R. J., & Swerdlik, M. E. (2009) *Psychological Testing and Assessment (7th Edition)*. New York, New York: McGraw-Hill
- Dywan & Segalowitz, S. J. (1996). Self and family ratings of adaptive behavior after traumatic brain injury: Psychometric scores and frontally generated ERPs. *Journal of Head Trauma Rehabilitation*, 11(2), 79-95.
- Ezrachi, O., Ben-Yishay, Y., & Kay (1991). Predicting employment in traumatic brain injury following neuropsychological rehabilitation. *Journal of Head Trauma Rehabilitation*, 6, 714.
- Flashman, L. A., & McAllister, T. W. (2002). Lack of awareness and its impact in traumatic brain injury. *Neurorehabilitation*, 17, 285-296.
- Fukuda, K. & Vogel, E. (2009). Human variation in overriding attentional capture. *The Journal of Neuroscience*, 29(27), 8726-8733.
- Giacino, Joseph T., Cicerone, & Keith D. (1998). Varieties of Deficit Unawareness after Brain Injury. *Journal of Head Trauma Rehabilitation*, 16(5), 1-15.

- Heaton, R. K., Chelune, G. J., & Lehman, R. A. (1978). Using neuropsychological and personality tests to assess the likelihood of patient employment. *Journal of Nervous and Mental Disease, Vol 166(6)*, 408-416.
- Kreutzer, J., & Sander, A. (1997). Issues in brain injury evaluation and treatment. *Rehabilitation Therapy, 42(3)*, 231-239.
- Leathem, J. M., Murphy, L. J., & Flett, R. A. (1998). Self- and informant-ratings on the patient competency rating scale in patients with traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology, 20*, 694-705.
- Lezak, M. D. (1989) In: *Assessment of the behavioral consequences of head trauma*. Lezak, M. D. (Eds). New York: Alan R. Liss, 116-143.
- Long, K., Rager, B., & Adams, G. (2014). Deficit awareness and cognitive performance in individuals with acquired brain injury. *Neurorehabilitation, 34(1)*, 45-5.
- Oddy, M., Coughlan, T., Tyerman, A., & Jenkins, D. (1985). Social adjustment after closed head injury: a further follow-up seven years after injury. *Journal of Neurology Neurosurgery and Psychiatry, 8(6)*, 564-568.
- Owensworth, T., McFarlan, K., Young, R. (2002). The investigation of factors underlying deficits in self-awareness and self-regulation. *Brain injury, 6(4)*, 291-309.
- Parente, R. and Herrmann, D. (2010). *Retraining cognition: Techniques and Applications*. Austin Texas: ProEd Publishers.
- Parente, Rager, and Adams. (2012). (<http://www.adamsquestionnaire.com/about-adams.html>)
- Prigatano, G. P. (1999) Impaired awareness, finger tapping and rehabilitation outcome after brain injury. *Rehabilitation Psychology, 44(2)*, 145-159.

- Prigatano, G. P., & Altman, I. M. (1990). Impaired awareness of behavioral limitations after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, *71*, 1058-1064.
- Prigatano, G. P., Fordyce, D. J., Zeiner, H. K, Roueche, J., Pepping, M., & Wood, R. C., (1990). *Neuropsychological rehabilitation after brain injury*. Baltimore: Johns Hopkins University Press.
- Prigatano, G., Gray, J., & Legacy, J., (2008). Predictors of quantitative and qualitative Halstead Finger Tapping scores and low socioeconomic status school-age children. *Child Neuropsychology*, *14*, 263–276.
- Rattok, J., Ben-Yishay, Y., & Lakin, P. (1992). Outcome of different treatment mixes in a multidimensional neuropsychological rehabilitation program. *Neuropsychology*, *6*, 395-415.
- Smeets, Sanne, Ponds, Rudolf, Verhey, Frans, Van Heugten, & Caroline. (2012). Psychometric Properties and Feasibility of Instruments Used to Assess Awareness of Deficits After Acquired Brain Injury: A Systematic Review. *Journal of Head Trauma Rehabilitation*. *27(6)*, 433-442.
- Sandhaug, M., Andelic, N., Berntsen, S., Seiler, S., & Mygland, A. (2012). Self and near relative ratings of functional level one year after traumatic brain injury. *Disability and rehabilitation*, *34(11)*, 904-909
- Sbordone, R. J., Seyranian, G. D., & Ruff, R. M. (1998). Are the subjective complaints of traumatically brain injured patients reliable? *Brain Injury*, *12(6)*, 505-15.
- Seel, R. T., Kreutzer, J. S., & Sander, A. M. (1997). Concordance of patients' and family members' ratings of neurobehavioral functioning after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, *78(11)*, 1254-59.
- Sherer, M., Bergloff, P., & Boake, C. (1998). The awareness questionnaire; factor analysis structure and internal consistency. *Brain Injury*, *12*, 63-68.

- Sherer, M., Hart, T., Nick, T. G. (2003). Measurement of impaired self-awareness after traumatic brain injury: A comparison of the Patient Rating Scale and the Awareness Questionnaire. *Brain Injury, 17(1)*, 25-37.
- Sveen, U., Mongs, M., Roe, C., Sandvik, L., Bautz-Holter, E. (2008). Self-rated competency in activities predicts functioning and participation one year after traumatic brain injury. *Clinical Rehabilitation, 22*, 45-55.
- Toglia, J., & Kirk, U. (2000). Understanding awareness deficits following brain injury. *NeuroRehabilitation, 15*, 57-70.
- Trudel, T. M., Tryon, W. W., Purdum, C. M. (1996). Close head injury, awareness of disability and long term outcome. *New Hampshire Brain Injury Association Annual Meeting*, Center of new Hampshire Convention Center, Manchester, NH.

## CURRICULUM VITA

Kayla Long

Experimental Psychology

Master of Science., 2016

Smithsburg High School, Smithsburg, MD: 2008

Collegiate institutions attended	Dates	Degree	Date of Degree
Hagerstown Community College	2008 – 09	Transfer	N/A
Frostburg State University	2009 – 12	B.S. Psychology	2012
Major: Psychology			
Minor: History			
Towson University	2012 – 17	M.S. Exp. Psychology	2017
Major: Experimental Psychology			

Professional publications:

Long, K., Rager, B., & Adams, G. (2014). *Deficit awareness and cognitive performance in individuals with acquired brain injury*. *Neurorehabilitation*, 34(1), 45-5.

Wheeler, L., Nickerson, S., Long, K., & Silver, R. (2014). *Expressive writing in people with traumatic brain injury and learning disability*. *Neurorehabilitation*, 34(1), 29-37.

Professional positions held:

Therapy Support Staff; Manito Inc.; 7564 Browns Mill Rd., Chambersburg, PA 17202	2015 – Present
Sales Representative; Victorias Secret; 17301 Valley Mall Rd., Hagerstown, MD 21740	2015 – Present
Manager, Regal Cinemas; 17301 Valley Mall Rd., Hagerstown, MD 21740	2013 – 2015
Sales Associate	2006 – 2013
Research Assistant, FSU; 101 Braddock Rd, Frostburg, MD 21532	2011 – 2012
Learning Assistant, FSU; 101 Braddock Rd, Frostburg, MD 21532	2011

