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The Usefulness of the Poreh Nonverbal Memory Test for the Assessment of Response Bias

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ASSESSMENT OF RESPONSE BIAS

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ABSTRACT

In the field of neuropsychology, there is a need for reliable measures that assess for both memory and effort (response bias). A sample of college students were instructed to feign memory deficits. They were administered two well established measures of response bias, the Test of Memory Malingering (TOMM) and the Reliable Digits Span (RDS), as well as the Poreh Nonverbal Memory Test (PNMT). The study shows that all of the three measures were able to identify students who were coached to demonstrate memory deficits. A more detailed analysis showed that the TOMM and the PNMT produced higher sensitivity and specificity then the RDS. Process analysis of the PNMT showed that the ability of this measure to detect response bias improved when one analyzed the distance between the target on geometric(simple) cards of the PNMT. Namely, during the delayed recall trial of the PNMT subject who feigned memory deficits clicked on more distant stimuli (from the target) then the control group.

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CHAPTER I

INTRODUCTION

In the field of neuropsychology, there is a need for reliable measures to assess the exaggeration or the manufacturing of cognitive deficits when there are incentives to gain for feigning symptoms. Response bias has been defined as the exaggeration of cognitive dysfunction for the purpose of material or monetary gain, or avoiding or escaping from a duty or responsibility (Slick et al., 1999; Millis & Volinsky, 2001). Research has shown that individuals often have many reasons that motivate them to malinger cognitive deficits, that can include financial compensation, avoiding criminal or work-related responsibility, gaining admission into a medical facility, justification for poor performance in various areas of functioning, and insurance benefits (Slovenko, 2002; Lacoursiere, 1993; Rosen & Taylor, 2007; and Resnick 1997). Response bias is thought to manifest as a complex set of behaviors that certain assessments may not adequately assess (Millis & Volinsky, 2001). Additionally, individuals can exhibit various types of response styles that include irrelevant, defensive, and malingering (Franklin & Thompson, 2005). Yet, despite the motivation or response style demonstrated, the need for clinicians to be able to reliably identify a type of biased responding from genuine disorders is essential in providing the necessary care and resources to those who need it.

Response bias can be seen in a multitude of settings across various fields (Millis & Volinsky, 2001). Previous literature suggests that while it is hard to report consistent prevalence rates for response bias, most commonly it is seen in situations where an individual is seeking compensation (Resnick, 1997). These types of situations seem to arise when an individual is being assessed for PTSD (Hall & Hall, 2007). It is common particularly in PTSD assessment due to the fact that the diagnostic process heavily relies on subjective symptom reports that are completed by the patients as well as the self-reported severity of an individual's emotional consequences following the trauma (Ahmadi, Lashani, Afzali, Tavalaie, & Mirzaee, 2013; Hall & Hall, 2007). Additionally, genuine PTSD often has a high rate of comorbidity of 65-98% with other psychological disorders which adds to its elevated symptom profile (Hall & Hall, 2007). Further, research has shown that PTSD like symptoms can be easily feigned and that many individuals who received a PTSD diagnosis exhibit a wide range of symptoms and severity of those symptoms vary (Ahmadi et al., 2013).

Even though self-report measures that are frequently used in neuropsychological evaluations, like the Minnesota Multiphasic Personality Inventory (MMPI), include scales that assess validity of a symptom profile, being able to distinguish biased responding from genuine PTSD has shown to be challenging (Lyons & Cox, 1999; Rogers et al., 2003). In a study that examined Vietnam war veterans, it was found that 39% of the veterans were over reporting their symptoms based on criteria for elevated scores on the MMPI O-S scales (scores >160) (Hyer et al., 1998). Furthermore, when symptom over reporting was analyzed, it was found that about 77% of veterans who were diagnosed with PTSD were unaware that they were over reporting their symptoms (Franklin, Repasky, Thompson, Shelton, & Uddo, 2003). While accurate diagnoses of PTSD are made, there is enough ambiguity that enables a wide range of individuals to convincingly feign the disorder. Some studies have examined the amount of biased responding in veteran populations who were being evaluated for PTSD and have found it to be as high as 20% for those who are seeking compensation (Frueh, Hamner, Cahill, Gold, & Hamlin, 2000). While PTSD claims are more frequent in veteran populations, they are in no way limited to only veterans and many civilian cases where an incident occurred is susceptible to an individual self-reporting symptoms of PTSD (Rosen & Taylor, 2007). For example, a case is described by Rosen and Taylor (2007) where 27 individuals who experienced a mudslide filed a class action law suit claiming that they were all suffering from PTSD following the mudslide (Murphy & Keating, 1995). Self-report measures (SCL-90-R and Impact Event Scale) were used to assess the amount of trauma symptoms the plaintiffs were experiencing and the results ultimately led to the amount of compensation each individual received (Rosen & Taylor, 2007).

Presently, there are several measures used to detect various response styles that are embedded within other standard neuropsychological tests such as the Reliable Digit Span (RDS), the F scales of the MMPI-II and the Digit Span of the Wechsler Adult Intelligence Scales (WAIS-R, WAIS-III, WAIS-IV) as well as the Wechsler Memory Scale (WMS-R, WMS-III, WMS-IV) (Arbisi & Ben-Porath, 1995; Greiffenstein, & Gola, 1994; Jasinski, Berry, Shandera, & Clark, 2011). While these assessments have yielded positive results for detecting feigning, there is still a need for additional reliable measures that significantly reduce response bias. There are several dedicated tests for the assessment of intentional feigned memory deficits that include the Test of Memory

Malingering (TOMM), Word Memory Test, Letter Memory Test, Validity Indicator Profile, and Portland Digit Recognition Test (Jasinski, Berry, Shandera, & Clark, 2011; Russeler et al., 2008). These measures all share a similar forced-choice memory paradigm where participants are first shown a stimulus or a set of stimuli and after a brief delay are asked to identify which stimuli they were previously shown from a list of choices. Research has shown that participants who are feigning obtain scores that are worse-than-chance (Jasinski, Berry, Shandera, & Clark, 2011). In these types of tests, participants believe that they must perform poorly even if the task itself is not difficult, results in a person scoring below chance (Russeler et al., 2008). While these tests are used to detect biased responding in clinical populations, they are very vulnerable to coaching, such as by legal workers, and scores can thus be unrepresentative. Coaching is most often seen in cases were an individual is trying to avoid legal responsibility (Dunn et al., 2003). In these instances, clients are often told to respond in a certain way that aids their legal case by feigning symptoms. Thus, if an individual can perform convincingly on these measures, results of neuropsychological assessments become unreliable.

Several studies examined the impact of coaching on neuropsychological test performance. Dunn et al. (2003) estimated that approximately 70% of patients that are assessed in a forensic context by a clinical neuropsychologist alter their cognitive and psychological presentations. Others have speculated that close to half of all workers' compensation claims may involve feigned cognitive deficits (Dunn et al., 2003). Some have even found that the prevalence of malingering and biased response styles for psychological symptoms and cognitive deficits varies from 1% to over 50%, but could potentially be as high as 47%, in worker's compensations cases and as high as 64% in personal injury cases (Resnick, 1997).

While biased responding is commonly seen in individuals feigning symptoms PTSD, it is also seen in patients who over report head trauma symptoms (Russeler et al, 2008). Memory impairment is a common and well documented symptom of brain injury that many individuals in the general public are aware of (Russeler et al., 2008). Research has shown that individuals who feign head trauma symptoms, which can follow a concussion or car accident for example, report memory difficulties and score very poorly on memory assessments (Russeler et al., 2008). Thus, tests have been created to test these so-called poor memory abilities which are used to detect poor effort. In these tests, participants are asked to remember about 15 different items in a small amount of time (Russeler et al., 2008). This type of test is actually very simple due to redundancy of the task yet, it also enables clinicians to easily spot biased responding. Patients with significant memory impairment perform without much difficulty on remembering the 15 items whereas an individual who is engaging in biased responding will perform very poorly and thus claim to recall very little (Russeler et al., 2008). Visual spatial memory tests are also utilized in neuropsychological memory assessments, where an individual’s ability to recall the position of an item in picture or ability to correctly draw an image after a delay is assessed (Poreh & Teaford, 2016). The most known tests for assessing visual spatial memory are the Rey Complex Figure and Wechsler’s Visual Reproduction Test (Loring & Papanicolaou, 1987; Wechsler, 1997; Yerkes, 1948). However, these tests are often critiqued as not true tests of visual spatial memory and learning but rather of retention (Loring & Papanicolaou, 1987). An individual who is demonstrating biased responding could perform as well as someone who has PTSD on these types of assessments if they are coached, leading to inaccurate results (Poreh & Teaford, 2016). Thus, there is a need for measures that more accurately assess visual spatial memory as it has the potential to be easily feigned on some of the current neuropsychological measures.

Since many assessments that are used in neuropsychological evaluations have become more susceptible to coaching, measures that are less amendable to such intercessions are needed. The Poreh Nonverbal Memory Test (PNMT) is a new measure of nonverbal memory that was created to assess for visual spatial /location memory deficits (Poreh & Teaford, 2016; Bryant, 2009). The PNMT is a computerized test which assesses visuospatial working memory, nonverbal learning, and reference memory (Kociuba, 2011; Phelan, 2013; Poreh & Teaford, 2016). The PNMT requires individuals to click on boxes that are arranged in different geometric formations until they select the correct target red box (Poreh & Teaford, 2016). The PNMT addresses several issues that previous nonverbal memory tests like the Rey Auditory Learning Test and the California Verbal Learning Tests-II face because it does not require grapho-motor skills and has the same amount of learning trials (Poreh & Teaford, 2016). Also, the PNMT reduces, if not eliminates, the need to use verbal strategies to remember the location of a target. On the PNMT, the ability to locate the target in space is done without the involvement of language, it is a process that appears to the casual observant as "automatic." Namely it has been suggested that locating a target in space is done without much thought, much like driving to work and at the same time listening to the radio (Poreh & Teaford, 2016). Therefore, when a person is attempting to bias their responses on this test they are likely to use inner speech (verbal instructions) to determine how they plan to respond. As such, they are not likely to not demonstrate any spatial learning curve or spatial memory and are likely to consciously select responses that are distant from the target (Poreh & Teaford, 2016).In sum, the purpose of this study was to determine whether the PNMT can serve not only as a measure of visual spatial memory test, as was previously shown (Poreh & Teaford, 2016; Teaford, 2016) but could also can be reliably used to assess for feigning of memory deficits. To this end 25 college students were instructed to feign memory deficits and 25 college students served as a control group. Several hypotheses were made.

Hypothesis 1: Subjects who were instructed to feign memory deficits will not evidence a learning curve on the PNMT.

Hypothesis 2: The scores on the PNMT will be able to identify between individuals who were instructed to feign "PTSD like" memory impairment from subjects who were instructed to perform the test without such instructions.

Hypothesis 3: Scores on the PNMT will highly correlate with scores on the TOMM Trial 1, Trial 2, and Retention, and RDS.

Hypothesis 4: Participants who are assigned to the feigning group will tend to purposely chose more distant stimuli relative to the target. This response bias would be most evident on (simple) cards that are easily remembered.

CHAPTER II

METHOD

Participants

Participants were recruited from Cleveland State University's online research participation system (SONA). A total of 50 undergraduates all taking an introductory course in psychology participated in this study. All participants were 18 years of age or older (*M=21; STD=6.58*). All participants received course credit for their participation in this study and were debriefed after its completion.

Instruments

"What is PTSD: What is Post Traumatic Stress Disorder?" A 1 minute 38 second video clip will be shown that explains in brief what PTSD is, how an individual can develop it, and typical symptoms that can be experienced.

The Test of Memory Malingering (TOMM). Research has shown that individuals with memory impairments perform well on stimulus recognition tasks where they are storing and retrieving visual information (Tombaugh, 1996). The TOMM (Tombaugh, 1996) is a forced-choice visual recognition 50 item measure that is used to assess effort. There are two learning trials that consist of a study and a test phase as well as a delayed retention trial. The TOMM has been shown to be a robust test to detect exaggerated or faked memory impairment (Tombaugh, 1996; Rees et al., 2001). Tombaugh (1996) further emphasizes that the TOMM is sensitive to feigned memory impairment, but is insensitive to genuine memory impairment as well as age and education. Any score that is lower than 45 on either of the two trials should be indicative of potential malingering (Tombaugh, 1996). Further, an individual should achieve a score of 50 on the retention trial if they are giving effort and attending to the task (Tombaugh, 1996).

Poreh Nonverbal Memory Test (PNMT). The Poreh Nonverbal Memory Test was developed by Dr. Amir Poreh. The PNMT is a test where the aim is to accurately locate the target stimuli that requires the use of spatial memory. There is a total of 6 trials, where each trial consists of 9 stimuli that are presented only once in the exact same order. The stimuli are comprised of 10 squares which together create an abstract geometric design. Participants are presented with the abstract geometric design and told to identify the target square within the design. When the correct square is selected, the participant is notified that the correct selection was made. Each stimulus is shown for 3 seconds and then the next design is presented. Trials 1-5 are learning trials and following a 30-minute delay the 6th trial, which is a recall trial, is administered (Phelan, 2013). The goal of the PNMT is to learn the location of the targets with as few incorrect selections as possible. The results will be recorded by hand on paper that has the 9 square geometric designs. The PNMT scoring has 4 indexes that examine an individual's ability to lay down new spatial memories (a learning curve), the absolute number of attempts for learning the spatial square design, the absolute number of attempts for learning the complex square design, and the absolute number of attempts for the delay trial (Poreh &

Teaford, 2016).

A simple trial learning score can be calculated for the simpler geometric card designs which is thought to be a potential useful sub-measure of the PNMT for identifying biased responding (Poreh & Teaford, 2016). Figure I shows an example of the geometric card design (card 1 and card 2). The simpler geometric designs are on cards 1, 3, and 5. The remaining 6 cards are considered more complex geometric designs. For the delay trial, the first two responses (clicks when given on electronically) are recorded. The distance of the first two clicks from target card was calculated using Pythagorean Theorem (Teaford, 2016; Appendix A).

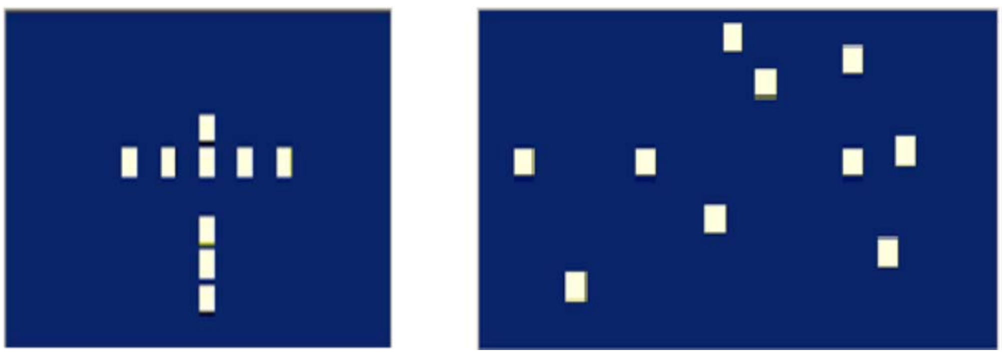

FIGURE 1: An example of a high and low spatial cued simple card design (Teaford, 2016)

Reliable Digit Span (RDS). The Digit Span (Yerkes, 1921) is a neuropsychological assessment that requires individuals to repeat a series of numbers back to the examiner. It has two trials, forward and backward. The forward trial requires that an individual repeats the series of numbers read to them by the examiner in the same order. The backward trial requires that an individual repeat the numbers the examiner told them in the reverse order they were presented. The reliable Digit Span (RDS) is then calculated by summing the longest forward and backward trials (Greiffenstein, Baker, &

Gola, 1994). Previous research has shown that the RDS is a well-validated measure of true effort (Greve et al., 2007). A score of 5 or below has been shown to correctly identify 61% of individuals who are engaging in biased responding with a false positive rate of 8% (Greve et al., 2007). Individuals with brain injury or deficits do well on the digit forward span. Thus, it is an indicator of biased responding if an individual score lower on forward span compared to backward (Yerkes, 1921).

General Procedure

Participants were randomly assigned to the feigning memory impairment condition or the control condition. All 50 participants were administered the PNMT, the TOMM, and the Digit Span. However, half the participants were also shown the video "What is PTSD: What is Post Traumatic Stress Disorder" prior to beginning the measures. The remaining were not shown this video and began the study following instructions.

Procedure – Control Condition. At the start of the study, all participants received a brief introduction and were administered the consent form. Following the initial instructions about the duration of the study, the instructions for the PNMT were explained. Participants in the control condition were told to select the target card with as few mistakes as possible for the first 5 trials. They were also instructed to give their best effort. Following completion of the 5 trails, the PNMT was set aside for a 30-minute delay. Next, the participant was administered the TOMM in which the directions from the manual were read aloud. The participant completed 2 trails and then the TOMM was set aside for a 15-minute delay. Next, the Digit Span was administered and participants were asked to repeat a string of numbers in forward and reverse order (Wechsler, 2008).

All responses were manually recorded by the test administrator. Once the participant was finished, he or she was administered the retention trial for the TOMM and the delay trial for the PNMT.

Procedure –Feigning Memory Impairment Condition. Participants in the memory feigning condition viewed the “What is PTSD: What is Post Traumatic Stress Disorder” video clip. They were then instructed to respond to the measures as if they themselves had a memory deficit. Additionally, they were also informed that they would be receiving reminders throughout the study that they should be responding how they think someone with a memory deficit would respond. Participants were then administered all the same measures as the control group in the same order. On completion of the study, participants were debriefed and asked if there were any remaining questions. Contact information was provided on a briefing form should participants come across any questions following the study.

CHAPTER III

RESULTS

General Analyses

All analyses for the PNMT, TOMM, and RDS were computed using SPSS Version 23 and Microsoft Excel Version 15.24.

Relationship Between the Cognitive Measures

The performance of the feigning memory impairment and control group on the 5 learning trials of the PNMT were plotted in Figure 2. Figure 2 shows that the learning curve of the control group was steep and robust whereas, the learning trial of the memory malingering group was flat and showed limited learning. Repeated measures analysis of variance confirmed this observation ($F=38.176, df=4, p<.0001$). An independent sample t-test was used to examine the learning curve for the control compared to the feigning memory impairment group for the delay trail and the same conclusion that resulted from the 5 learning trials can be drawn suggesting that the controls showed significantly better performance on the delayed trial ($t=-6.978, p<.0001$). Again, independent t-test analyses of the response bias measures (TOMM and RDS) also produced similar significant findings. Namely, the TOMM trial 1 total score was significantly different for the two groups ($t=10.57, p<.0001$), the TOMM trial 2 total score was significantly different for the two groups (*t=10.939, p<.0001*). The TOMM delay was also significantly different from the two groups (*t=10.793, p<.0001*). The RDS score was also significantly difference between the two groups (*t=4.803, p<.0001*).

Pearson correlation analysis was used to examine the relationship between the various measures in this study. Table I shows that all the measures were significantly highly inter-correlated. On closer examination the TOMM was more highly inter-correlated with the PNMT total delay score and total learning score (*r=-.83, p<.01; r=-.83, p<.01*) than the RDS (*r=.592, p<.01*). Figure III exhibits the TOMM trial 1 correlation with the PNMT total learning score and Figure IV illustrates the TOMM trail 1 with the PNMT total amount of clicks for the delay trial. The results show that once the malingering memory participant scored beyond a certain level, there was remarkable linear decline on performance on both measures. Therefore, the more a participant exaggerated memory deficits on trial 1 of the TOMM, the more exaggerated their performance was on the PNMT. While a similar phenomenon also occurred with the PNMT and RDS, it was not as pronounced.

Following the Quantified Process Approach (Poreh, 2000) a question was raised as to whether particular patterns of performance of the PNMT would better predict the subjects' performance on the TOMM. To this end, a stepwise multiple regression analysis was conducted with the dependent variable being the total score of TOMM trial one and the predictors being total performance on card 1 of the PNMT, total performance on the 3 simple geometric designs (Card 1, 3, and 5), PNMT total learning score, and RDS total score. Table II shows that only the PNMT total card 1 entered the model with the PNMT total simple (total clicks for card 1, 3, and 5), and the RDS total score being left out. This indicates that these are not as good predictors of response bias compared to the total clicks for PNMT total card 1 across the 5 trials. The total amount of clicks for PNMT card 1 alone is a strong predictor of performance on TOMM trail 1, however the total PNMT learning score explains a significant additional amount of the variance in TOMM trial 1 overall performance. Thus, the amount of total clicks a participant has on card 1 for each of the 5 trials is indicative of exaggerated performance.

Another stepwise multiple regression was conducted where the RDS total score was used as the dependent variable and the PNMT total card 1, PNMT total learning, and total simple designs were used as predictors (observed in Table III). In this analysis, again only the PNMT total card 1 entered into the model. Namely, when using the RDS as our measure of response bias, the PNMT total card 1 was the best predictor on this index but was not as robust as the TOMM.

FIGURE 2

PNMT Total Learning Trials 1-5 For Controls Compared to Experimentals

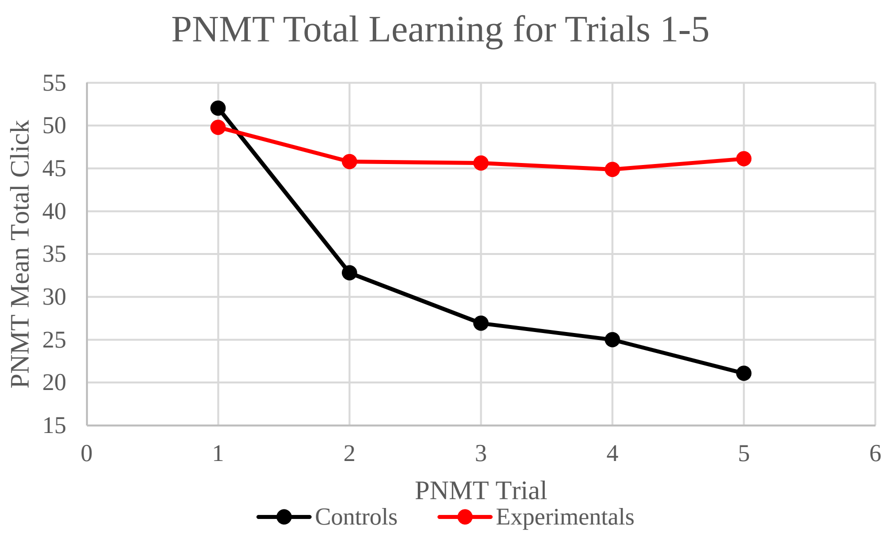

Table I

Correlations for Cognitive Measures

	TOMM Trial 1 Total	TOMM Trial 2 Total	TOMM Retention Trial Total	PNMT Total Clicks Delay Trial	PNMT Total Learning Score	RDS Total Score
TOMM Trial 1 Total	1	.952**	.947**	**-.830****	**-.830****	.592**
TOMM Trial 2 Total	.952**	1	.985**	-.751**	-.795**	.589**
TOMM Retention Trial Total	.947**	.985**	1	-.746**	-.783**	.601**
PNMT Total Clicks Delay Trial	-.830**	**-.751****	**-.746****	1	.904**	-.477**
PNMT Total Learning Score	-.830**	**-.795****	**-.783****	**.904****	1	-.536**
RDS Total Score	**.592****	.589**	.601**	-.477**	-.536**	1

**. Correlation is significant at the 0.01 level (2-tailed).

FIGURE 3

Correlation Between TOMM Trial 1 Total Scores and PNMT Total Learning Score

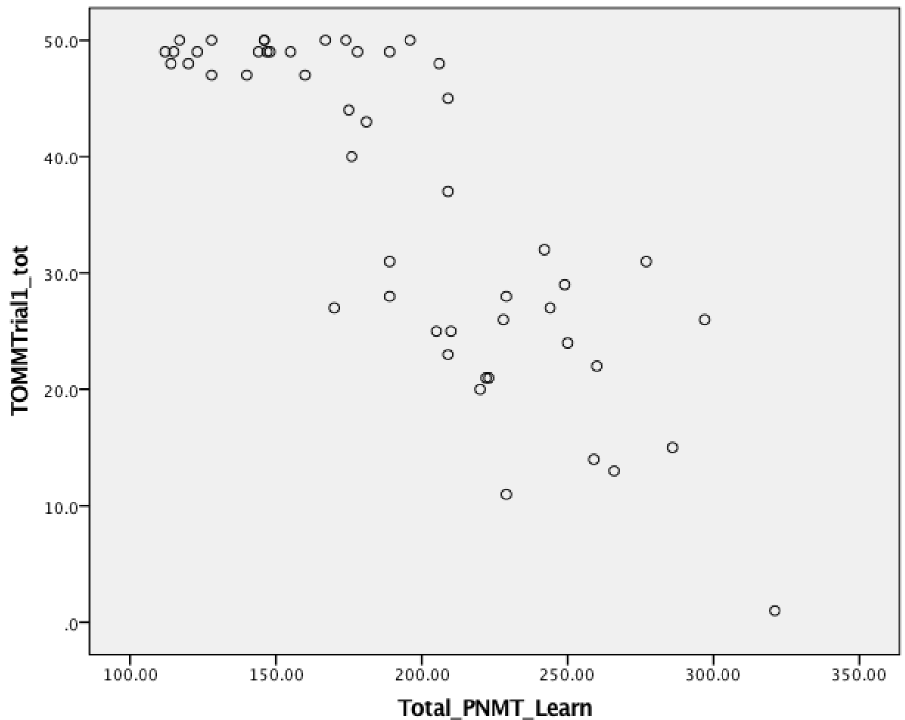

FIGURE 4

Correlation Between TOMM Trial 1 Total Scores and PNMT Total Clicks for the Delay Trial

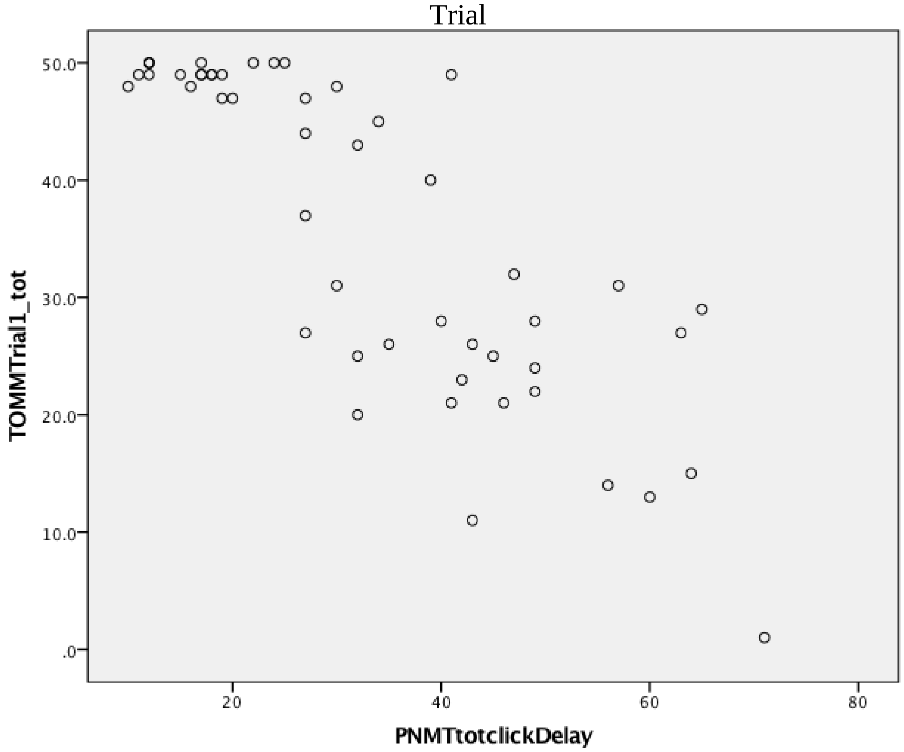

TABLE II
Stepwise Regression Model for TOMM Trial 1

Model	R	R^2	Adjusted R^2	R^2 Change	F Change	Sig. F Change
1	.831[a]	.691	.685	.691	107.360	.000
2	.880[b]	.774	.765	.083	17.301	.000

a. Predictors: (Constant), PNMT_TotalCard1
b. Predictors: (Constant), PNMT_TotalCard1, Total_PNMT_Learn

TABLE III
Stepwise Regression Model for RDS Total Score

Model	R	R^2	Adjusted R^2	R^2 Change	F Change	Sig. F Change
1	.580[a]	.336	.323	.336	24.342	.000

a. Predictors: (Constant), PNMT_TotalCard1

Evaluation of Sensitivity and Specificity

It was hypothesized that each of the measures examining effort would be able differentiate well between the feigning memory impairment and control groups. The ROC Curve Analysis was calculated for the PNMT 5-trial learning, the TOMM trial 1, trial 2, and retention, as well as for the PNMT click distance for cards 1, 3, and 5. An ROC curve is a statistical method that is used to visualize the performance of a binary classifier (Fawcett, 2006). It illustrates that a classifier is successfully differentiating between two classes if the curve is closely hugging the left corner of the plot (Fawcett, 2006). An ROC curve analysis was used since this study consisted of two very distinct groups – the control group whom were presumably giving their best effort and those feigning memory impairment. The Area Under the Curve (AUC) is a percentage that demonstrates how closely a curve is fitting to the upper-left quadrant of the graph. Therefore, if a measure has no utility, its plot would not depart from the 45° line (Millis & Volinsky, 2001). Previous research on ROC curve analysis has suggested that an AUC value of 0.8 is considered good, 0.65-0.7 is considered fair, and anything that is 0.5 or below is considered poor (Fawcett, 2006). The closer that the AUC approaches 1, the better the measure is (Millis & Volinsky, 2001).

The results of the ROC analysis are presented in Figure 5 and 4, and Table IV and V. Figure 5 and Table IV shows that the sensitivity and specificity of the RDS (AUC=.84) while good, was not as robust as that of the TOMM at identifying those who were feigning memory impairment from those who are not (TOMM Trial 1 AUC=.96; Trial 2 AUC=.96; Retention AUC=.97). Figure 4 and Table V show that the sensitivity and specificity of the PNMT total distance between the first 2 responses for the simple design cards (cards 1, 3, and 5) was still comparable at accurately identifying between the two groups (Simple Designs AUC= .948). Additionally, the sensitivity and specify for the PNMT learning trial was slightly lower than that of the TOMM but still comparable (PNMT learning trial AUC=.926). Since results of the multiple regression showed that the total amount of clicks for PNMT card 1 were correlated with performance on TOMM trail 1, we were interested to see if the total clicks for PNMT card 1 for the delay trial yielded similar results for sensitivity and specificity. However, when examining the total clicks for card 1 for the delay trial, the sensitivity and specificity were low, about equal to chance and was not a good indicator (Simple Card 1 AUC=.522). Therefore, distance between the first 2 clicks on the PNMT simple cards is a better indicator if an individual is intentionally feigning memory deficits.

FIGURE 5

Sensitivity and Specificity the TOMM Trial 1 Total, Trial 2 Total, Retention Trial Total, and RDS Total

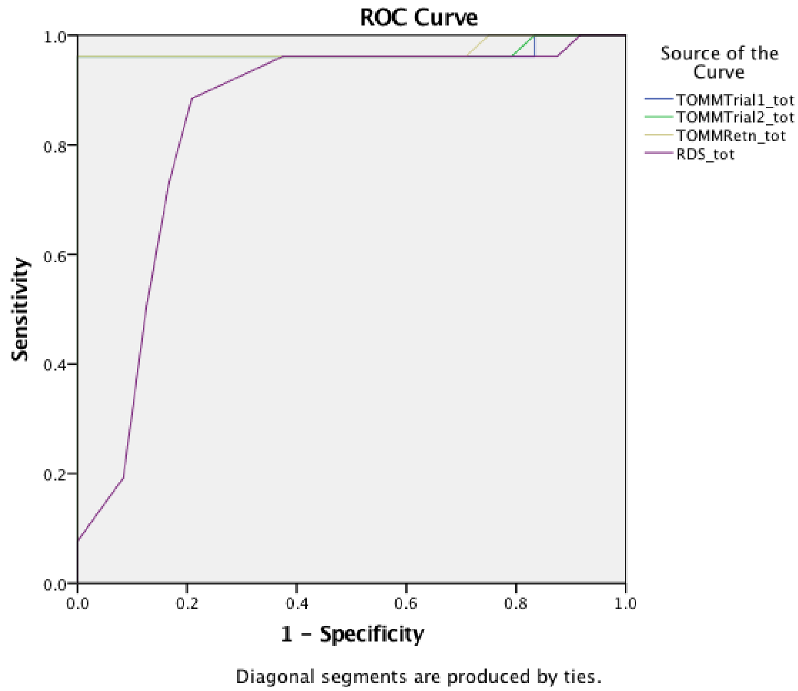

TABLE IV

Area Under the ROC Curve For the TOMM Trial 1 Total, Trial 2 Total, Retention Trial Total, and RDS Total

Test Result Variable(s)	Area
TOMMTrial1_tot	.968
TOMMTrial2_tot	.969
TOMMRetn_tot	.972
RDS_tot	.844

The test result variable(s): TOMMTrial2_tot, TOMMRetn_tot, RDS_tot has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

FIGURE 6

Sensitivity and Specificity the PNMT Distance of Simple Cards, Distance of Card 1 &3, PNMT Total Learning, and PNMT Trial 1 for Simple Cards

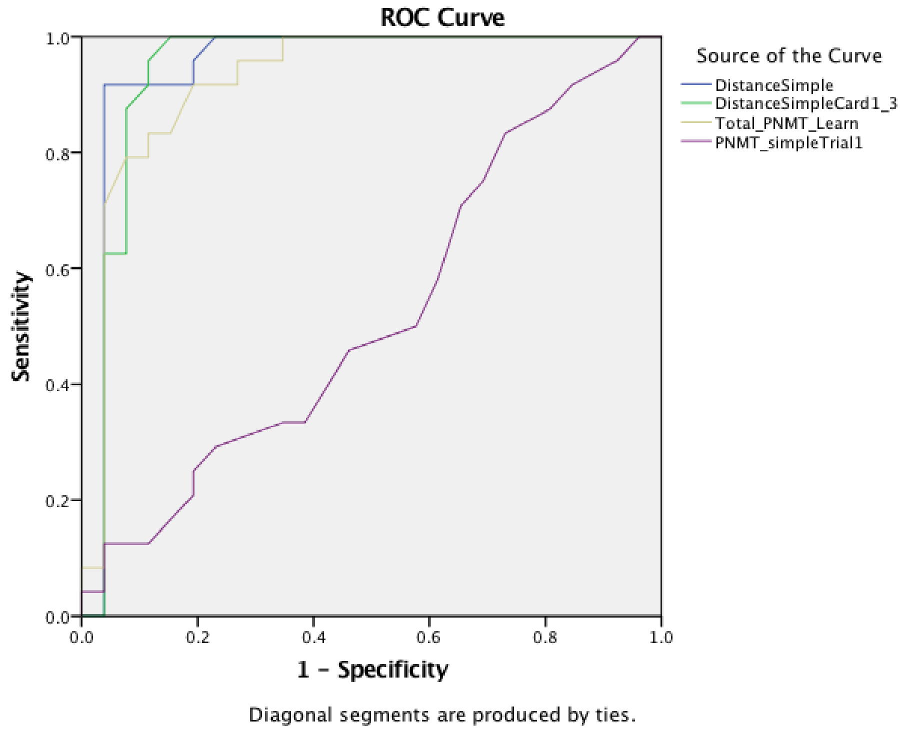

TABLE V

Area Under the ROC Curve For PNMT Distance of Simple Cards, PNMT Total Learning, and PNMT Trial 1 for Simple Cards

Test Result Variable(s)	Area
DistanceSimple	.948
Total_PNMT_Learn	.926
PNMT_simpleTrial1	.522

The test result variable(s): DistanceSimple, Total_PNMT_Learn, PNMT_simpleTrial1 has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

CHAPTER IV

DISCUSSION

The goal of the present study was to examine the ability of the PNMT to identify response bias. To this end it was hypothesized that current measures would demonstrate good construct validity amongst each other and these measures will also correlate with the PNMT. The present study confirmed that the TOMM is an extremely good measure in identifying response bias which supports the previous literature on its usability in accurately identifying those who are engaging in biased responding (Franklin et al., 2003). It was also shown that the RDS is a strong measure of response bias, although it is to a lesser extent than the TOMM (Greiffenstein et al., 2008; Greve et al., 2007). This finding could be due to the nature of the two measures. Since the TOMM is a forced choice recognition test an individual must chose a response to progress forward (Schindler, Kissler, Kuhl, Hellweg, & Benger; 2013). In the case of individuals who engage in biased responding studies have shown that some further exaggerate their responding when given dual choice answers (Schindler, Kissler, Kuhl, Hellweg, & Benger; 2013).

Several hypotheses were examined in this study. The first hypothesis proposed that individuals who were feigning memory impairment would not exhibit a learning curve on the 5 learning trials of the PNMT. This hypothesis was also supported as only the control group exhibited a learning curve across the 5 learning trials. The feigning memory impairment group did not demonstrate any true learning across the 5 trials which supports that this group was consistently following the instructions to feign deficits.

The second hypothesis was that the PNMT will be an accurate measure for identifying the feigning of memory impairment. This hypothesis was supported as an analysis of sensitivity and specificity yielded a comparable result to that of the TOMM indicating that the PNMT was close to, if not equaling, the TOMM in feigned memory performance identification.

The third hypothesis predicted that the PNMT scores would correlate with scores on the TOMM and the RDS, indicative of high construct validity. This hypothesis was supported for the TOMM as the total learning score and total amount of clicks for the delay trial of the PNMT were highly correlated with scores on TOMM trial 1, r=-.83, p<.01. However, this hypothesis was only partially supported for the RDS. The PNMT was found to correlate with the RDS to a lesser extent, r=5.92, p<.01. This could potentially suggest that the TOMM and the PNMT are better indicators for identifying feigned impairment than the RDS. Several studies have examined the true positive rates of the RDS and found that it can accurately distinguishing between those who are feigning symptoms from those who are not at a true positive rate of 47% (Strauss et al., 2002; Schwarz, Gfeller, & Oliveri, 2006). Schwarz, Gfeller, and Oliveri (2002) found that the RDS was able to accurately classify the sample of their participants who were giving poor effort 62.5% of the time, which is similar to results found in the present study. These findings suggest that RDS should not be used in isolation when assessing for poor effort or response bias as there is an increased risk for mislabeling an individual as giving poor effort when they are not (Schwarz, Gfeller, & Oliveri, 2006).

The fourth hypothesis predicted that participants who were assigned to the feigning condition would purposely chose more distant responses relative to the target and this bias would be more evident on the cards with the simpler geometric designs. This hypothesis was also as participants in the feigning condition selected cards that were farther from the target on the delay trial for the simple design cards (cards 1, 3, and 5). This suggests that the simple design cards are a reliable indicator for biased responding on the PNMT.

This is the first study to show that the PNMT can also identify response bias at a rate similar to that of the TOMM. In the literature, the TOMM is considered the gold standard for the identification of response bias (Rees et al., 1998; Dunn et al., 2003; Greiffenstein, 2008; Millis & Volinsky, 2001). However, since it has been in use for over 2 decades, like other tests that measure effort, it is a familiar test and thus is prone to coaching (Brennan et al., 2009). Several studies have found that the TOMM is vulnerable to coaching and could produce unreliable results (Suhr & Gunstad, 2000; Brennan et al., 2009). Unlike the TOMM, the PNMT is a less familiar test and is potentially more complex making not as readily amendable to coaching. The results of this study suggest that if an individual is trying to teach others how to intentionally feign certain deficits, he or she would have a considerable amount of difficulty in doing so for the PNMT because the complexity of the indices that are used to identify response bias.

In various fields such as medicine, psychology, and the law, there is an increasing need for reliable, easily accessible measures to screen for the exaggeration or the manufacturing of feigned symptoms. Based on the findings of this study it is suggested that the PNMT could potentially be one of those reliable measures. The PNMT when used in combination with other measures that assess for response bias and poor effort could potentially lead to a more accurate identification of feigning individuals. Measures that are valid and not easily susceptible to coaching are needed in various fields where prevalence rates for feigning individuals are high (Rogers, Sewwll, & Goldstein, 1994; Lees-Haley, 1997). The impact that a new nonverbal visuospatial memory test could have on resources, legal implications, and providers is immense.

Limitations

As with all studies, the present study had several potential limitations. First, the present study's sample was made up of a neurologically healthy "normal" population. This is a limitation because unlike in patients with lateralized lesions or neurological disorders, it does not allow for distinctions as to what type of memory the test measures in normals. Another potential limitation of this study was sample size. Since the sample collected was small, it is possible that the findings would not carry over to the larger population. Additionally, students who were told to feign memory deficits were used as the simulated response bias condition. It is possible that some students may have been more representative of true biased responding than others so generalizing to all who exhibit response bias within in the larger population is limited. A final limitation is that these results were not compared to clinical populations. Since students were used on the memory impairment condition, the results are not generalizable to patients who experience dementia or other illnesses that cause memory decline.

Future Research

To better understand the potential impact the Poreh Nonverbal Memory Test has on identifying poor effort in response bias a larger, more comprehensive, sample should be collected. Future studies should examine performance on the PNMT for patients who are intentionally biasing their responses. Additionally, examining performance on the PNMT in groups with well-defined brain dysfunction such as dementia, or lateralized neurological deficits and comparing results to those who are malingering would potentially provide substantial clinical support for the use of the PNMT in biased response style identification. It would also be useful to compare performance on the PNMT to other measures of nonverbal memory such as the Rey Design Learning Test and the Visual Reproduction I and II task of the Weschler Memory Scale III and IV. In conclusion, the PNMT can be a useful measure in detecting response bias, and also potentially a useful tool for clinicians and researchers who are trying to evaluate nonverbal visual spatial memory.

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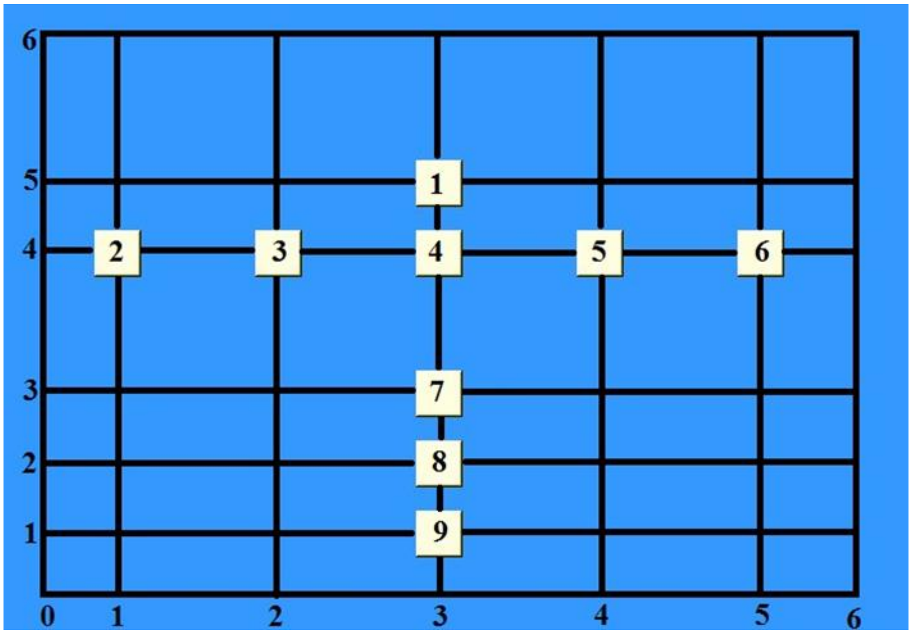
APPENDIX A

Card 1 Numbering System and Card 1 Distances (Target is Box 8)

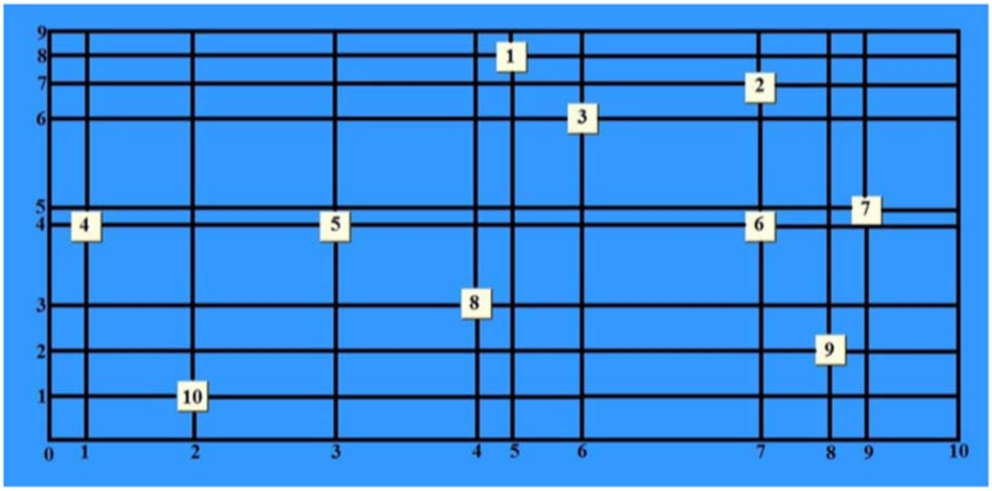
Simple Design



Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	3
2	2.83
3	2.24
4	2
5	2.24
6	2.83
7	1
8	0
9	1

Card 2 Numbering System and Card 2 Distances (Target Box is 6)

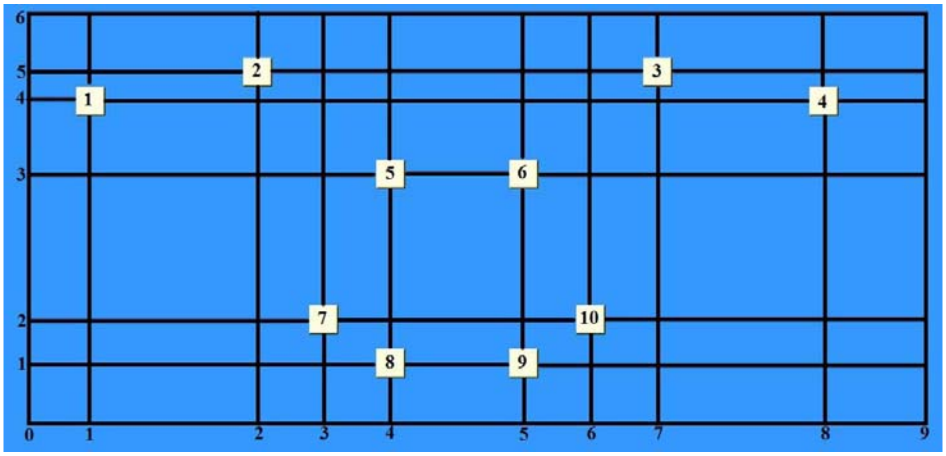


Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	3
2	2.83
3	2.24
4	2
5	2.24
6	2.83
7	1
8	0
9	1

Card 3 Numbering System and Card 3 Distances (Target Box is 8)

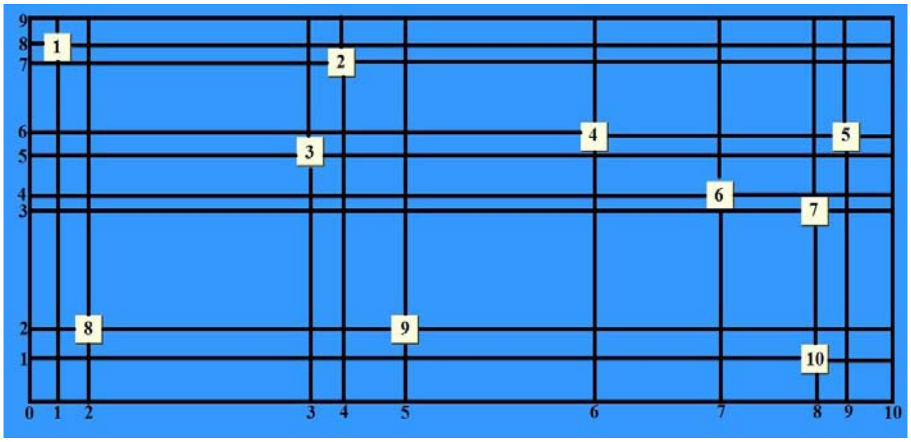
Simple Design



Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	4.24
2	4.47
3	5
4	5
5	2
6	2.24
7	1.41
8	0
9	1
10	2.24

Card 4 Numbering System and Card 4 Distances (Target Box is 2)

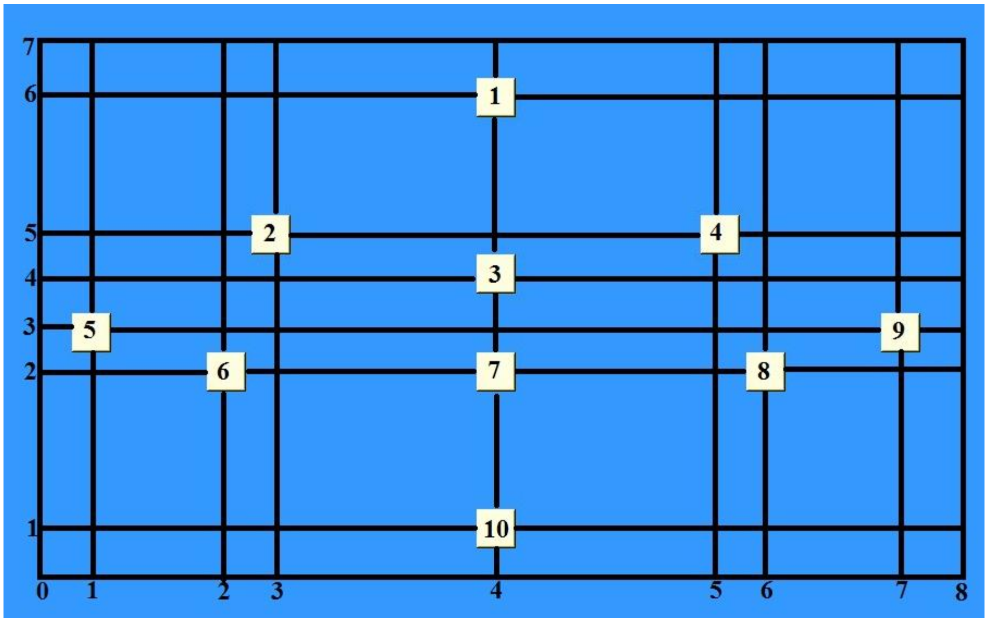


Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	3.16
2	0
3	2.24
4	2.24
5	5.1
6	4.24
7	5.66
8	4.47
9	5.1
10	7.21

Card 5 Numbering System and Card 5 Distances (Target Box is 6)

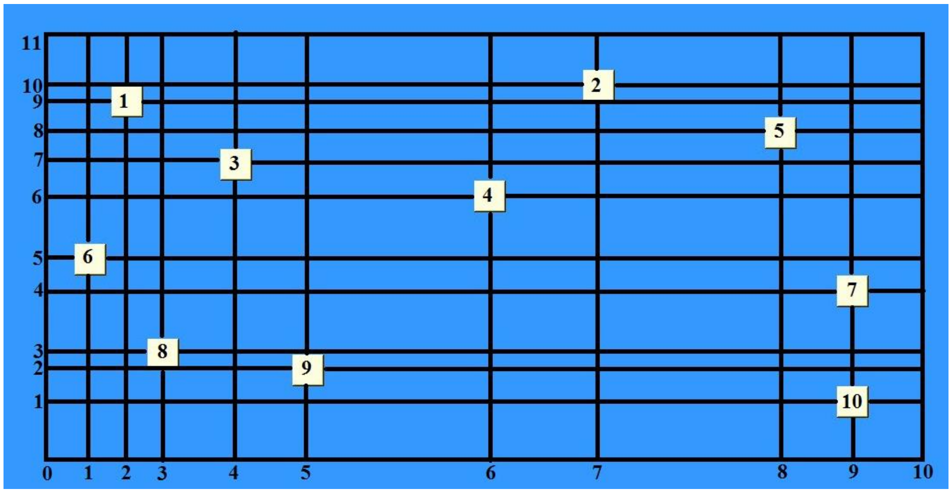
Simple Design



Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	4.47
2	3.16
3	2.83
4	4.24
5	1.41
6	0
7	2
8	4
9	5.1
10	2.24

Card 6 Numbering System and Card 6 Distances (Target Box is 1)

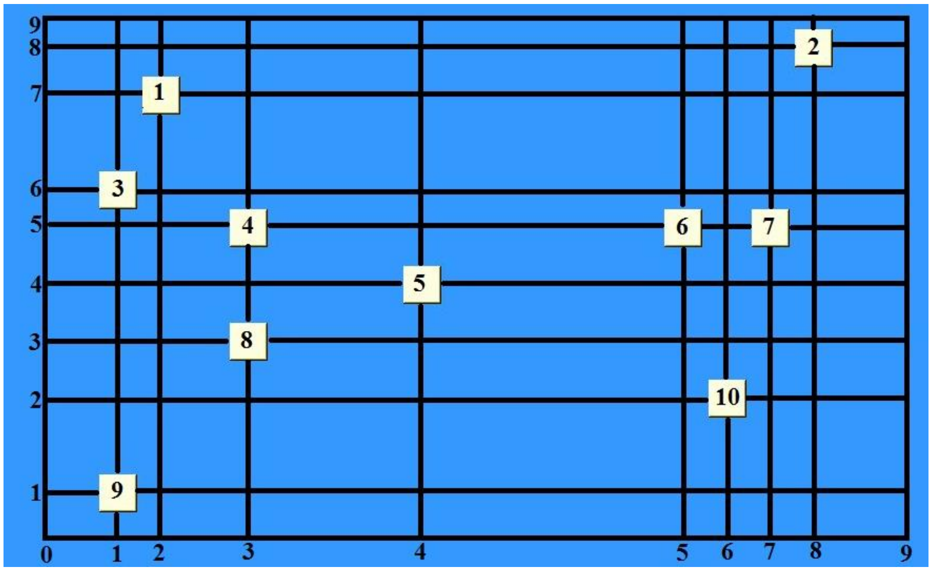


Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	0
2	5.1
3	2.83
4	5
5	5.1
6	4.12
7	8.6
8	6.08
9	9.22
10	10

Card 7 Numbering System and Card 7 Distances (Target Box is 4)

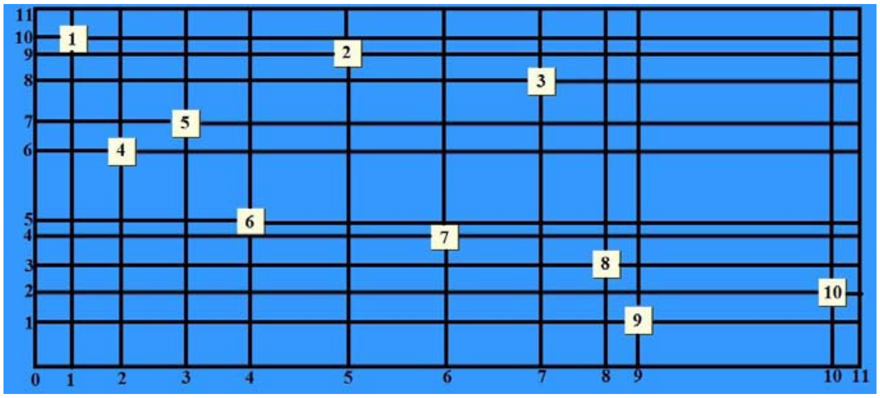
Simple Design



Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	2.24
2	6.08
3	2.24
4	0
5	1.41
6	2
7	4
8	2
9	4.47
10	4.24

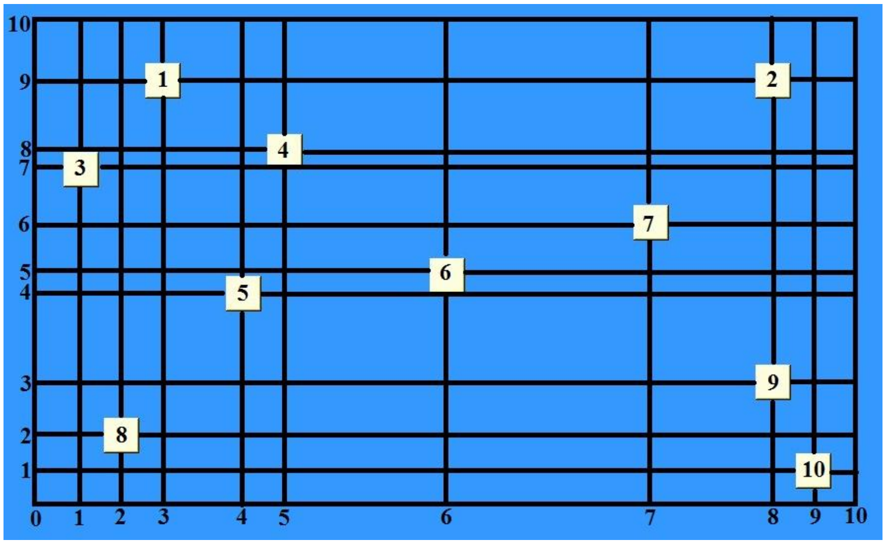
Card 8 Numbering System and Card 8 Distances (Target Box is 9)



Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	12.04
2	8.94
3	7.28
4	8.6
5	8
6	6.4
7	4.24
8	2.24
9	0
10	1.41

Card 9 Numbering System and Card 9 Distances (Target Box is 4)



Distances Calculated using Pythagorean Theorem (Teaford, 2016)

Target	Distance from Target
1	2.24
2	3.16
3	4.12
4	0
5	4.12
6	3.16
7	2.83
8	6.71
9	5.83
10	8.06