A PRELIMINARY STUDY OF THE REVISED ANNA THOMPSON PROSE
MEMORY ASSESSMENT IN OLDER ADULTS

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ABSTRACT

Prose memory assessment has been used in neuropsychology since the first intelligence tests were developed in the 20th century (Yerkes, 1921). In the current study, a new method (Poreh’s Adaptation of Yerkes’ Logical Prose, PAYLP) for administering the Anna Thompson prose memory assessment was created by presenting the story three times to a sample of older adults. The researchers hypothesized that the multiple trial presentation of PAYLP would produce a positive logarithmic learning curve, and that participants would have the best memory performance on Trial 3 of the PAYLP. It was also hypothesized that age and education would correlate with PAYLP performance. A 3x3 repeated measures ANOVA (n=35) indicated a significant main effect of PAYLP Trial on memory performance. Paired samples t-tests showed significantly better performance on Trial 3 in comparison to both Trial 2 and Trial 1. There were significant learning curves for PAYLP ($R^2 = .9979$) and PNMT ($R^2 = .9564$). There were no significant correlations between education or age on PAYLP performance. The results suggest that significant learning for prose does occur with three trial presentation. Future research with a larger sample size and participants with brain injury are needed to establish whether this new adaptation accurately predicts memory and learning in comparison to the single trial presentation paradigm.

Keywords: prose memory, verbal memory, learning, psychological assessment
TABLE OF CONTENTS

ABSTRACT ................................................................................................................................. iv
LIST OF TABLES .......................................................................................................................... vii
LIST OF FIGURES ....................................................................................................................... viii
CHAPTER

I. INTRODUCTION ..................................................................................................................... 1
  1.1 Background and Purpose ................................................................................................. 1
      1.1.1 Background .............................................................................................................. 1
      1.1.2 Purpose of the Study ............................................................................................. 1
  1.2 Frameworks and Models of Memory .............................................................................. 2
  1.3 Working Memory ............................................................................................................ 4
  1.4 Neuroanatomy and Memory ........................................................................................... 4
      1.4.1 Brain Lateralization and Memory ......................................................................... 4
      1.4.2 Brain Structures Associated with Memory ......................................................... 5
  1.5 Neuroanatomical Basis of Memory During Aging ......................................................... 7
  1.6 Prose Memory ................................................................................................................ 8
  1.7 Aging on Prose Memory .................................................................................................. 10
  1.8 Education and Prose Memory Performance ................................................................ 11
  1.9 Assessment of Prose Memory ....................................................................................... 13
  1.10 Justification for Revised Prose Memory Assessment .................................................... 15
  1.11 Hypotheses .................................................................................................................. 16

II. METHODS ............................................................................................................................ 18
  2.1 Participants ..................................................................................................................... 18
  2.2 Measures ........................................................................................................................ 19
  2.3 Procedure ....................................................................................................................... 21
  2.4 Analyses ........................................................................................................................ 22

III. RESULTS ................................................................................................................................ 24
  3.1 Learning Curve of the PAYLP ....................................................................................... 24
3.2 Learning Curves of PNMT ................................................................. 26
3.3 Repeated Measures ANOVA of PAYLP ............................................ 30
3.4 Paired Samples t-test of the Three Trials of PAYLP ....................... 32
3.5 Correlation Analyses ......................................................................... 33
   3.5.1 Correlations for Age and Education with PAYLP ..................... 33
   3.5.2 Correlations for Age and Education with ROCF and PNMT ......... 34
   3.5.3 Correlations for PAYLP Trial 1, PNMT Session 1, and ROCF Copy and 3 Minute Delay ................................................................. 35
   3.5.4 Correlations for Delayed Recall of PAYLP, PNMT, and ROCF .. 36
IV. DISCUSSION ......................................................................................... 37
   4.1 Implications .................................................................................. 37
   4.2 Limitations .................................................................................... 39
REFERENCES .......................................................................................... 42
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>PAYLP Learning Trials: Descriptive Statistics</td>
<td>25</td>
</tr>
<tr>
<td>II.</td>
<td>PNMT Learning Trials: Descriptive Statistics</td>
<td>27</td>
</tr>
<tr>
<td>III.</td>
<td>PNMT Simple Designs: Descriptive Statistics</td>
<td>28</td>
</tr>
<tr>
<td>IV.</td>
<td>PNMT Complex Designs: Descriptive Statistics</td>
<td>29</td>
</tr>
<tr>
<td>V.</td>
<td>PAYLP Learning Trials Performance by Age Group</td>
<td>31</td>
</tr>
<tr>
<td>VI.</td>
<td>Paired Differences between PAYLP Learning Trials</td>
<td>32</td>
</tr>
<tr>
<td>VII.</td>
<td>Correlations for Age and Education with PAYLP Trials</td>
<td>33</td>
</tr>
<tr>
<td>VIII.</td>
<td>Correlations for Age and Education with PNMT and ROCF</td>
<td>34</td>
</tr>
<tr>
<td>IX.</td>
<td>Correlations for PAYLP Trial 1, PNMT Trial 1, and ROCF Copy</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>and 3 Minute Delay</td>
<td></td>
</tr>
<tr>
<td>X.</td>
<td>Correlations for PAYLP Delayed Recall, PNMT Delayed Recall, and</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>ROCF 20 Minute Delay</td>
<td></td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PAYLP Learning Curve</td>
<td>25</td>
</tr>
<tr>
<td>2. PNMT Total Learning Curve</td>
<td>27</td>
</tr>
<tr>
<td>3. PNMT Simple Design Learning Curve</td>
<td>28</td>
</tr>
<tr>
<td>4. PNMT Complex Figure Learning Curve</td>
<td>29</td>
</tr>
<tr>
<td>5. PAYLP Learning Trials by Age Group</td>
<td>31</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

1.1 Background and Purpose

1.1.1 Background

Memory for prose is one component of the cognitive domain of memory. This form of memory assessment has been utilized since the 20th century for the assessment of intelligence (Yerkes, 1921). Studies show that as individuals age, their memory for prose, when it is assessed after one or two presentations, declines (Wechsler, 1945a). However, it is unclear whether this decline is due to attentional components or learning difficulties.

1.1.2 Purpose of the Study

The current study examined the relationship between age and learning through the formation of a new prose memory assessment, Poreh’s Adaptation of Yerkes’ Logical Prose (PAYLP). The PAYLP involves the introduction of multiple trials of prose to the examinee. This revision intends to more accurately evaluate whether information has been encoded, processed, and retrieved during the process of memory in comparison to
current measures. Given previous studies regarding memory for prose and aging a population of older adults (individuals aged 60 and above) was researched as the target population for this study. The results of this study may assist in assessing prose memory in older adults and help in the evaluation of verbal memory and learning deficits.

1.2 Frameworks and models of memory

Memory is composed of neural connections that fire when new stimuli are presented, processed, and stored. Melton (1963) proposed that memory involves three stages: encoding, storage, and retrieval. When an individual encounters new material, such as reading a story for the first time, he or she is engaging in the encoding process. This process continues as the story is presented multiple times and is rehearsed. Once the information has been properly encoded, it enters the storage phase in which a representation for that memory is created. Melton’s (1963) final stage, the retrieval process, allows encoded and stored information to be taken out of memory and used. These stages are dependent on each other and if one of the processes fails, then memory deficits can occur.

The human brain has the ability to store information for both short and long periods of time. Working memory (WM) is the ability to retrieve information presented within a limited time span, such as immediately recalling a story after presentation. Delayed recall (DR) involves retrieving information that has been introduced over a longer period of time. The information from WM can be successfully stored into long term memory (LTM) and later retrieved and recalled. The potential for information to surpass WM and continue into LTM storage can be assisted by repetition techniques.
Robinson-Riegler and Robinson-Riegler (2008) state that repetition is an essential component to retention of material, and thus aids in the learning process.

LTM can be divided into two prominent categories: declarative and nondeclarative memory. Nondeclarative memory refers to unconscious memory, such as memory for acquired skills (Squire, Knowlton, & Musen, 1993). Declarative memory involves recalling consciously presented information such as memory for facts or general knowledge. Episodic memory, the ability to remember past events and the time involving them, is a form of declarative memory and is associated with prose memory (Squire et al., 1993; Tulving, 1972). After the initial learning of material, it is reorganized in the brain and consolidated for LTM storage (Squire et al., 1993). Retaining episodic information in LTM is dependent upon the strength of the initial learning and the rate in which the person forgets (Squire et al., 1993). An individual with episodic memory deficits may require multiple presentations of information in order for it to be properly encoded, retrieved, and stored.

Examining accuracy in recall and recognition of presented stimuli aids in the distinction between intact and impaired cognitive episodic memory. Recall involves spontaneously remembering presented information without the use of cues, whereas recognition utilizes them. Both recall and recognition have been suggested to depend on declarative memory (Hirst et al., 1986; Haist et al. 1992). Therefore, in order to adequately assess an individual’s performance on a prose memory task, it is imperative to examine immediate and delayed recall and recognition of the story.
1.3 Working Memory

One of the most prominent theories explaining the encoding and retrieval phases of memory is Baddeley’s model of WM (Baddeley, 2000). The vital feature of Baddeley’s model of WM is the central executive, the system for attentional control and supervisor to the other subsystems, the phonological loop and visuospatial sketchpad. These two systems store and rehearse verbal, auditory, and visuospatial information. Baddeley revised this model and incorporated the episodic buffer, which allows integration and communication between the phonological loop and the visuospatial sketchpad (Baddeley, 2000). Because the phonological loop is associated with all verbal processing, it can act as the major subsystem for verbal memory. Once the information enters the phonological loop and rehearsed, it can be gathered into WM and begin the process of long-term storage.

1.4 Neuroanatomy and memory

1.4.1 Brain lateralization and memory

Researching cognitive functions begins with determining brain lateralization and hemispheric dominance. Although both hemispheres in normal brains are generally symmetrical and communicate with each other via the corpus callosum, they vary in function. The left and right hemispheres can be identified as either dominant or nondominant, depending on one’s handedness. The hand that shows dominance is associated with that contralateral hemisphere as also being dominant. According to Blumenfeld (2010), about 90% of the world’s population is right handed. Thus, the left hemisphere is usually the dominant hemisphere in most right-handers.
The dominant hemisphere is associated with language functions related to verbal memory and attention (Schoenberg & Scott, 2011). Evidence from case reports show that individuals with left hemisphere lesions are more susceptible to cognitive deficits in verbal memory and those with right hemisphere lesions are vulnerable to visuospatial memory deficits (Campbell, 1990). These conclusions have also been supported by neuroimaging studies in which activation of the left hemisphere occurs during verbal memory tasks (Awh, et al., 1996; Fiez et al., 1996) and activation of right hemisphere during nonverbal memory tasks (Jonides, et al., 1993).

1.4.2 Brain structures associated with memory

The human brain is composed of cortical and subcortical tissue that play a vital role in the sustenance of the human memory system. The brain’s four lobes are composed of subcortical and cortical tissue, and if brain damage occurs to these structures specific cognitive deficits may develop. The temporal and frontal lobes have been associated with higher order processing, such as the cognitive domains of attention, processing speed, executive functioning, and memory.

Research has shown that the medial temporal lobe and the hippocampus are centers for memory function (Ranganath & Ritchey, 2012). Squire et al. (1993) states that damage to either the medial temporal lobe (including the hippocampus) or the thalamus will most likely cause severe memory impairment. Additionally, both the medial temporal lobe and medial thalamus extend to the frontal lobe, in which damage to these structures may affect frontal lobe cognition (Squire et al., 1993). Damage to a center for memory may affect an individual’s performance on other cognitive domains.
such as language, processing speed, and executive functioning. Therefore, understanding anatomic frameworks of memory is an important aspect for interpreting global cognitive function.

Imaging studies have demonstrated that structures such as the prefrontal cortices, thalamus, and hippocampus become activated during verbal memory tasks (Awh et al., 1996; Braver et al., 1997; Cohen et al., 1997; Veltman et al., 2003). Bedwell et al. (2005) utilized functional magnetic resonance imaging (fMRI) techniques to assess brain activation regions during encoding, maintenance, and retrieval aspects of a verbal memory task. Results showed dominant hemisphere activation in frontal cortices, hippocampus, and thalamus.

Determining active brain structures during recall and recognition tasks help determine centers of encoding, retrieval, and consolidation activity. Areas such as the prefrontal cortex and medial temporal lobe show activation on positron emission tomography (PET) imaging during episodic memory tasks (Kapur, et al., 1995; Nyberg et al., 1995; Schacter et al., 1996). McDonough, Wong, and Gallo (2012) found significant fMRI activation in the dorsolateral prefrontal cortex (DLPFC) during visual and verbal episodic memory recall and recognition tasks. The activation in the DLPFC was significant in the younger aged participant group on word list recall tasks. During a recognition task, there was significant activation in the posterior middle frontal gyrus (MFG) for correct rejections of nonstudied words. Imaging techniques such as fMRI and PET scans demonstrate that regions in the thalamus, hippocampus, and temporal and frontal lobes of the brain show consistent activation during recall and recognition memory tasks.
1.5 Neuroanatomical basis of memory during aging

Zhang et al. (2011) examined the relationship between brain activation and cognitive performance of older adults. Results on fMRI imaging showed left middle temporal and bilateral hippocampal activation during story memory tasks. Decline in memory may be associated with atrophy or volume loss that occurs in these regions as individuals age (Zhang et al., 2011).

A study conducted by Weis et al. (2011) demonstrated other brain activation areas during verbal memory tasks in normally aging adult and Alzheimer’s disease (AD) samples. For the normal aging participants, fMRI imaging showed brain activation in left temporal areas. The significant activation in the temporal lobe and hippocampus are both areas that are important when encoding semantic information (Wise et al., 1991). The AD patients showed a similar positive correlation between accurate memory performance and activation in temporal, right frontal and left hippocampal areas. These results suggest that the temporal lobe processes semantic information in prose memory tasks and is associated with intact verbal encoding performance in normally aging older adults. In the AD group, the activation in the left hippocampus suggests that when the brain degenerates, it occurs in areas surrounding the hippocampus and encoding in the temporal areas may not be possible. Therefore, the brain may attempt to compensate for this deficit by increasing activation in the hippocampal areas.

Overall, the prominent areas of the brain that demonstrate activation in both normal and demented individuals surround the frontal and temporal lobes. In general the dominant (left) hemisphere still seems to be the prominent hemisphere for verbal memory
function in older adults. The more severe the volume loss in hippocampal regions, the more likely the brain will engage in compensatory behavior surrounding this area for memory function and increase activation in frontal brain regions.

1.6 Prose memory

Prose memory involves encoding, retrieving, and maintaining semantics and contextual information for stories. Kintsch and van Dijk (1978) propose that prose memory is complex because it not only involves rapid encoding, but also requires an individual to maintain propositions of the earlier presented textual information. If an individual is able to maintain the propositions of the text, then he or she should be able to remember the contents of the story and improve memory for it (Petros et al., 1990). At long time intervals, the propositions or general knowledge of the story becomes important for passage-specific recall (Dooling & Christiaansen, 1977). Attending to an entire story and additionally learning the material from the passage proves to be difficult in assessment of complete passage learning (Cofer, 1941; Hunter, 1964). Prose memory involves comprehending the story in addition to memorizing its material.

Cornish (1978) assessed the quality of recall for nine different stories in a sample of undergraduate students. There was a positive correlation between the number of clauses and the number of words produced. These results imply that the more words a person provides, the more likely they are to be complete clauses rather than key words. When utilizing complete clauses, the semantics of the story are also likely to be intact. This suggests that individuals who have intact prose memory performance may
understand and comprehend the meanings of the stories in addition to being able to recall phrases verbatim.

Presenting a story multiple times will help increase recall as well as assist in maintaining the story’s meaning. This may help differentiate between WM abilities and learning processes that occur when completing LTM storage. Single-presentation of stimuli may not strongly demonstrate an individual’s ability to learn the story but may be an assessment of WM abilities such as attention. Battig (1979) suggest that single presentation of stimuli is insufficient for adequate processing for LTM. Johnstone, Vieth, Johnson, and Shaw (2000) assessed verbal and nonverbal memory and learning performance in individuals with cognitive dysfunctions such as traumatic brain injury, dementia, and cerebral vascular accident. Researchers compared performance on the first trial of task exposure to overall changes in items recalled over multiple trials. In general, less items were recalled on the first trial in comparison to subsequent trials. There was a significant positive learning curve that appeared when assessing performance across multiple trials of verbal and visual memory tasks.

Multiple presentations of verbal information enhance an individual’s ability for learning and recall. When a story is only presented once, the assessment of performance may be measuring WM abilities instead of true learning. A story may need to be presented to an individual more than once to exhibit a positive learning curve and thus encode and store that information into LTM.
1.7 Aging on prose memory

Older adults generally have poorer performance on prose memory tasks in comparison to younger individuals because of the increased likelihood of developing cognitive impairments. The resource-deficit hypothesis may be one explanation as to why performance on prose memory tasks decline with age (Hartley, 1993). This hypothesis suggests that as people age, their cognitive functions become limited in amount or accessibility and thus their ability to recall prose information can be negatively affected (Hartley, 1993).

Johnson, Storandt, and Balota (2003) propose another possibility for poor performance on prose memory tasks in older adults. They suggest that this impairment is related to Baddeley’s three-component model of WM involving the episodic buffer (Baddeley, 2000). The interaction between the restraints of the central executive in relation to the episodic buffer and phonological loop may provide insight into the storage and retrieval difficulties that some older adults may experience. If the capacity is too strong for either of these systems, the central executive will have its resources drained and the information may not be stored in the long-term. This is a process called decay, in which information is lost and may provide part of the explanation for memory loss. Decay cannot itself be the sole explanation for memory loss or cognitive impairment (Robinson-Riegler & Robinson-Riegler, 2008).

There are contradictory findings regarding the memory maintenance processes over time. Maintenance can be evaluated by timed delay tasks in memory assessments, and research has demonstrated that some of these maintenance processes may have age-related impairments (Anders, Fozard, & Lillyquist, 1972; Byrd, 1986; Craik
Rabinowitz, 1985) whereas others have not found impairments (Boaz & Denney, 1993). Gazzaley et al. (2007) hypothesized that these discrepancies may be due to inconsistencies in the approach to testing delayed recall and recognition. Recall tasks require storage and retrieval of all information from the story in order to have successful performance whereas recognition tasks allow the discard of less important contents of the story. A typical recall task involves free recall in which the individual must try to remember all contents of the memory task. When the scoring of these delay assessments require word-for-word recall, it may be difficult for older adults to obtain high scores because recall for prose typically is not word for word (Johnson et al., 2003). Johnson et al. (2003) found that for the word for word delayed recall task of a story, nondemented older adults (mean age=73.45 years) recalled less information about the story than younger adults (mean age=20.00 years). Therefore, the current measures of these maintenance processes in older adults provide inconsistent and inconclusive results. Assessing multiple items on both recall and recognition may provide more substantial information on whether these WM maintenance processes stay intact as people age.

1.8 Education and prose memory performance

Other demographic variables in addition to age may have an effect on prose memory (Lee, Yuen, Chu, & Chi, 2004). Lee et al. (2004) studied the impact of education on prose memory assessment in older adults. Participants were split up into highly educated older adults (mean education level = 13.22 years), low education elderly (mean education level = 4.73 years), and high education young adult group (had a university degree or were working on obtaining a degree). Results showed a significant
main effect of education in which the highly educated older adults had better performance than low educated older adults on recall and recognition accuracy. Additionally, the low education elderly group made significantly more false recognitions on the recognition task than the high education elderly group.

Abikoff et al. (1987) investigated this topic further by collecting norms for age and education on the Logical Memory portion of the WMS-I. Researchers scored the Logical Memory forms by both verbatim responses (word-for-word) as well as by gist responses (general context of the story). Individuals younger than 60 had about 14 years of formal education, those between 60-70 years about 13, and those older than 70 had on average 12 years of formal education. Participants with higher education scored significantly better on the test for both verbatim and gist scoring methods. Correlations revealed that education had a greater impact on performance than age, which suggests that it may be a better predictor of prose memory performance.

An explanation for this implication may be that those with higher education have greater verbal ability (Hultsch & Dixon, 1984) and a higher capacity to create strategies for remembering the stories. Those with higher education also may be more comfortable in a test-taking situation because of school experience and ability to focus on the task and block out distractions (Gonda, Quayhagen, & Schaie, 1981; Hayslip & Kennelly, 1985). Zivian and Darjes (1983) found significant correlations between years of formal education, performance on a verbal memory task, and number of strategies that the participants used to remember the target words. Individuals with higher levels of education remembered more words and utilized more mnemonic strategies to recall the
words. The results of these studies suggest that education does play a role in one’s ability to properly encode, store, and retrieve information about stories into LTM.

1.9 Assessment of prose memory

The study of prose memory is of great interest to both clinicians and researchers. In addition to utilizing word list recall, prose memory recall is one of the primary methods when assessing verbal memory (Perri, Fadda, Caltagirone, & Carlesimo, 2013). The early use of prose memory was made by intelligence test developers. Yerkes (1921; pp. 142) presented some of the most commonly used prose by psychologists at that time including the Anna Thompson, the American Ocean Liner New York, the Dogs in War Time and the School Children in Northern France stories. He also provided a detailed word for word breakdown of the stories.

Wechsler (1945b) adopted these stories for the creation of his memory scales (Wechsler Memory Scale I and II). The format of the presentation was identical to Yerkes’ with the exception of different words and phrases. The participant was read a story and was then asked to recall it. After the participant recalled the first story the examiner read a second story and once more was asked to recall it. In later versions of the Wechsler Memory Scales developed by the Psychological Corporation (WMS-III; Wechsler, 1997 and WMS-IV; Wechsler 2009), the first story was read twice.

When intelligence and memory assessments were initially developed, there was no universal method for scoring the subtests. Russell (1975) was one of the first researchers to develop a word-for-word scoring method for prose memory assessments, specifically in relation to the Logical Memory subtest of the WMS. In the 1970s a
growing number of clinicians argued that the word by word scoring criteria was restrictive and did not give any credit for the recollection of general ideas (Johnson et al., 2003). This stringent scoring method could result in misdiagnosing or inadequately assessing individuals with normal range cognitive abilities as having cognitive deficits.

To address this limitation some researchers provided a scoring criteria that awarded half a unit to the recollection of non-verbatim ideas (Schear, 1986; Sweet & Kolden, 1986) while others created a separate scale to capture this dimension (Wechsler, 2009). Other researchers have proposed to conduct a detailed propositional analysis adopted from the Computerized Propositional Idea Density Rater, third version (CPIDR₃) (Covington, 2007). This type of analysis involves dividing up the context of sentences through their propositions, or distributing them into the smallest units of discourse that still maintains the meaning of the sentence or phrase (Turner & Greene, 1977). Propositional analysis attempts to have less strict scoring criteria than word by word scoring and places more emphasis on assessing the importance of word phrases or whole ideas.

In addition to the target story, it is also imperative to include an intrusion or interference story to help further assess memory deficits in prose memory. Individuals who cannot determine differences in contextual themes of the target story and identify intrusion of the interference story are likely to have cognitive deficits. Mayes (1992) suggests that an interference task can help assess presence of confabulations and perseverative behavior that further differentiate between mild and moderate memory impairment.
1.10 Justification for Revised Prose Memory Assessment

One of the major changes of the WMS-IV is that it created distinct age group testing batteries: the Adult (ages 16-69) and Older Adult Batteries (ages 65-90) (Wechsler, 2009). Specifically, the Older Adult testing battery has fewer and shorter subtests than the Adult battery. This change attempts to make the testing session less physically and mentally exhausting for older adults. This adaptation of the testing assessment also demonstrates that an individual’s abilities and skills required for memory may change quantitatively (Zelinski, Light, & Gilewski, 1984).

Although the WMS-IV has improved on some of the shortcomings of the WMS-III, it still contains some deficiencies specifically within the Logical Memory I and II portions. The WMS-IV Logical Memory I includes two short stories. For the Older Adult battery, the first story is read off in two trials and the second story only contains one trial. This deficiency does not account for the potential learning curve that may occur during a prose memory assessment if the story is presented multiple times.

The Recognition portion may be susceptible to guessing because it is formatted in a series of “Yes/No” response questions. Individuals have a 50% change of getting the answer correct if he or she does not remember the contents of the target story and has to resort to guessing. This flaw does not present a truly objective measure for assessing storage of information that a multiple choice measure may provide. Gass (1995) recreated a five-option multiple choice recognition portion for the Logical Memory subtest of the Wechsler Memory Scale-Revised (WMS-R) and administered it to patients with brain injury and psychiatric illness. Both groups identified significantly more information on the recognition portion than the free recall task. Although this study was
not conducted on a normative sample, it does demonstrate that a multiple choice - format for recognition is an appropriate method for assessing whether an individual’s memory deficits, if present, involve retrieval and/or storage based deficits. The current study not only creates a multiple-choice format for the recognition portion, but also includes details from the interference story as one of the four options. This may aid in determining whether individuals are able to successfully discriminate differences between the two stories.

Therefore, the new assessment will attempt to buffer against the inconsistencies of the Logical Memory I and II portions of the WMS-IV. The current measure revises the Logical Memory I prose memory assessment story by providing multiple trial presentation of the Anna Thompson target story. Additionally, the current measure strives to revise the Recognition aspect of Logical Memory II by creating an objective answering portion in place of the Yes/No format.

1.11 Hypotheses

The current study strives to demonstrate the presence of a positive learning curve for verbal memory assessment of Poreh’s Adaptation of Yerkes’ Logical Prose (PAYLP) in the older adult population. The study will also compare the learning curves of verbal and nonverbal memory assessments, specifically between the PAYLP and the Poreh Nonverbal Memory Test (PNMT) to assess whether they exhibit similar learning curves.

Additionally, the researchers hypothesize that as a result of the positive learning curve, participants’ performance on the third trial of the Anna Thompson measure will be significantly better in comparison to first trial performance. We predict that there will be
a relationship between PAYLP Trial 1, PNMT Session 1, and ROCF Copy and/or 3 Minute Delay, suggesting that initial trials function as WM assessments. There will be relationships between PAYLP Delay, ROCF 20 Minute Delay, and PNMT Delay. Also, we hypothesize that there will be relationships between education and memory performance as well as between age and memory performance. Specifically, younger participants will remember more details about the stories and those with higher education will also have better memory performance.
CHAPTER II

METHODS

2.1 Participants

Forty-four (34 females, 10 males) individuals participated in this study. The participants were recruited from various community centers, senior centers, and institutions where older adults frequent in a Midwestern city. Individuals who scored below a 26 on the MoCA (n=4) were not included in the analyses, and only individuals who scored equal to or higher than a 26 (n=40) completed the full battery of tests. Individuals who scored lower than 35 (n=5) on the first learning trial of the Poreh Nonverbal Memory Test (PNMT) were considered outliers and were not included in the overall analyses. After screening for normal adults and controlling for outliers, a total of 35 participants (25 females, 6 males) were included in the analyses and were divided into three separate age ranges: 60-69 (n=11), 70-79 (n=14), and 80+ (n=10).
2.2 Measures

Montreal Cognitive Assessment (MoCA)

The participants needed to complete the Montreal Cognitive Assessment (MoCA) to screen for cognitive impairment. The MoCA is a 30-item, cognitive screening test that assesses the cognitive domains of visuospatial/ executive functioning, memory, attention, and language (Nasreddine et al. 2005). It also assesses naming abilities, abstraction skills, and orientation to time, date, and place. A score equal to or greater than 26 denotes intact cognitive functioning. Individuals who scored a 25 or below on the MoCA were not included in the study’s analyses.

Rey- Osterrieth Complex Figure Test (ROCF)

The Rey- Osterrieth Complex Figure Test (ROCF) is visual memory and perception task (Delaney, 1999). The first task on the ROCF is a copy trial in which the stimulus is presented and the examinee copies the image on a separate sheet of paper. Then, the stimulus is removed and three minutes later an immediate recall task is administered. Following a 20 minute delay, a delayed recall task is administered in which the examinee must draw the figure from memory. The number of elements that the examinee accurately includes in the copy, immediate recall, and delayed recall tasks are assessed and scored using the Bennett-Levy scoring approach.

Poreh Nonverbal Memory Test (PNMT)

The Poreh Nonverbal Memory Test (PNMT) is a computerized nonverbal memory and learning task. There are nine configurations of white boxes that appear on a
computer screen. The examinee is instructed to click the white boxes with a computer mouse until a box turns red. When a white box turns red the computer will indicate that the correct box has been identified and allow the examinee to study the configuration for ten seconds before the next configuration is shown. The examinee will complete these nine configurations over five trials. The nine configurations consist of both simple (symmetrical) and complex (asymmetrical) designs. Following a fifteen minute delay, the examinee is administered the delayed recall task. The number of clicks it takes to reach the red box for each configuration determines learning over time. The lesser clicks it takes to reach the red box, the more learning the examinee has experienced.

Individuals who score a 35 or less on overall total learning for Session 1 were considered outliers and not included in the overall data analyses. If a participant is considered an outlier, the data cannot be interpreted because their low scores are not indicative of learning the task, they simply were able to guess correctly.

Poreh’s Adaptation of Yerkes’ Logical Prose (PAYLP)

Poreh’s Adaptation of Yerkes’ Logical Prose (PAYLP) is a new assessment that strives to modify current measures of prose memory. The PAYLP was adapted from the Anna Thompson story of Yerkes’ Logical Prose from the Army Alpha Test (Yerkes, 1921). The content of the PAYLP remains true to the original Anna Thompson and Nancy Snow stories, but was modified in order to be adaptable to modern culture and practices.

The PAYLP consisted of presenting the Anna Thompson story three times, which are considered the learning trials. After each presentation of the Anna Thompson story,
the examinee participates in a free recall task. Then, the Nancy Snow story is to be presented once as an interference story and as a recall task.

Following the three learning trials and the interference story, an immediate recall task for the Anna Thompson story is administered. There is a 30 minute Delayed Recall and Recognition task, and the filler tasks are to be completed during this time frame. Once thirty minutes have elapsed, the examiner presents the examinee with the Delayed Recall of both the Anna Thompson and Nancy Snow stories. Following the Delayed Recall portion of the PAYLP, the researchers immediately administer the Recognition task. This portion consists of 13 multiple choice questions relating to the Anna Thompson story, all with four possible responses, one of which is the correct response. The participants are encouraged to pick the response that most closely relates to the Anna Thompson story for each of the 13 questions.

2.3 Procedure

The participants were tested individually and met with the researcher at various public but private testing environments such as libraries, local community centers, or classrooms. Testing administration lasted about 45 minutes. The neuropsychological assessments of the MoCA, PNMT, ROCF, and PAYLP were administered to research participants by the principal investigator or trained research assistants. The participants completed a short demographic questionnaire containing questions about age, education, gender, and if applicable, any current medical conditions. The participants were first administered the MoCA to screen for cognitive deficits.
If the participants obtained an appropriate MoCA score to continue the testing, they were administered the learning trials of the PAYLP. After completing the three learning trials of the PAYLP Anna Thompson story, the participants completed the Nancy Snow interference and Anna Thompson immediate recall tasks. Then the examiner administered the filler tasks.

The participants then completed the ROCF Copy trial, the demographic questionnaire, and ROCF 3 Minute Delay task. Following the ROCF 3 Minute Delay task, participants completed the learning trials of the PNMT. Time to complete the PNMT took about 15 to 20 minutes. Once the PNMT task was completed and 20 minutes had elapsed, the participants were administered the 20 Minute Delay portion of the ROCF task.

After the ROCF 20 Minute Delay was completed, the researchers administered the Delayed Recall and Recognition portions of the PAYLP. Immediately following, the participants completed the Delayed Recall portion of the PNMT, were informed that the testing was completed, and were thanked for their cooperation and participation.

2.4 Analyses

A two-way 3x3 repeated measures analysis of variance (ANOVA) (PAYLP Learning [Trial 1 vs. Trial 2 vs. Trial 3] x Age Group [60-69 vs. 70-79 vs. 80+]) was run to assess the overall significance of prose memory and learning between the three learning trials on the PAYLP. The dependent variable of learning was the number of key items that the participant remembered about each story. There was a total of 25 items for each of the three learning trials of the PAYLP.
Paired samples \( t \)-tests were conducted to assess the differences between learning on Trials 1-3 of the PAYLP. Logarithmic learning curves were analyzed for PAYLP and PNMT performance. Nonparametric Spearman correlations were analyzed for Trial 1 of the PAYLP and the ROCF Copy and 3 Minute Delay trials to assess working memory. Nonparametric Spearman correlations between delayed recall task performance and PAYLP, ROCF, and PNMT were also assessed. Lastly, nonparametric Spearman correlations were run to assess relationships between demographic variables and the three memory assessments (PAYLP, ROCF, PNMT).
CHAPTER III

RESULTS

3.1 Learning curve of the PAYLP

Descriptive statistics for the three learning trials of the PAYLP were examined to compare the range of mean learning for each trial (see Table 1). A logarithmic learning curve was analyzed for mean performance on the three learning trials of the PAYLP. Results showed a positive learning curve with $R^2 = .9979$, almost a perfect learning curve (see Figure 1). This demonstrates that multiple trial presentation can be a significant predictor of verbal learning for older adults. As the information is presented over three trials, the participants learned significantly more information.
Table 1

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAYLP Trial 1</td>
<td>6</td>
<td>20</td>
<td>12.51</td>
<td>3.67</td>
</tr>
<tr>
<td>PAYLP Trial 2</td>
<td>10</td>
<td>24</td>
<td>17.71</td>
<td>3.33</td>
</tr>
<tr>
<td>PAYLP Trial 3</td>
<td>10</td>
<td>25</td>
<td>20.25</td>
<td>2.70</td>
</tr>
</tbody>
</table>

N=35

Figure 1: PAYLP Learning Curve

$R^2 = 0.9979$
3.2 Learning curves of PNMT

Descriptive statistics were also examined for the PNMT to assess mean learning over the course of five trial presentation (see Table 2). A logarithmic learning curve was analyzed for mean performance on the five learning trials of the PNMT. Results revealed a learning curve with $R^2$ value = .9564, suggesting that it is a predictor of nonverbal learning across five trials for older adults (see Figure 2). The participants required less clicks to reach the correct target as they progressed through the learning trials.

Descriptive statistics were examined for PNMT simple and complex designs (see Tables 3 and 4). Learning curves were also analyzed for the simple and complex designs of the PNMT, showing $R^2 = .8435$ for simple designs and $R^2 = .9868$ for complex designs (see Figures 3 and 4).
Table 2

PNMT Learning Trials – Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNMT S1</td>
<td>41</td>
<td>73</td>
<td>53.06</td>
<td>7.16</td>
</tr>
<tr>
<td>PNMT S2</td>
<td>28</td>
<td>62</td>
<td>43.17</td>
<td>9.09</td>
</tr>
<tr>
<td>PNMT S3</td>
<td>22</td>
<td>63</td>
<td>40.43</td>
<td>9.53</td>
</tr>
<tr>
<td>PNMT S4</td>
<td>15</td>
<td>53</td>
<td>37.31</td>
<td>8.87</td>
</tr>
<tr>
<td>PNMT S5</td>
<td>19</td>
<td>61</td>
<td>37.26</td>
<td>10.56</td>
</tr>
</tbody>
</table>

N=35

![Figure 2: PNMT Total Learning Curve](image)

R² = 0.9564

- Total Mean Performance
- Log. (Total Mean Performance)
Table 3

PNMT Simple Design – Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNMT S1</td>
<td>13</td>
<td>33</td>
<td>23.69</td>
<td>5.33</td>
</tr>
<tr>
<td>PNMT S2</td>
<td>6</td>
<td>26</td>
<td>16.23</td>
<td>5.11</td>
</tr>
<tr>
<td>PNMT S3</td>
<td>8</td>
<td>28</td>
<td>15.54</td>
<td>5.47</td>
</tr>
<tr>
<td>PNMT S4</td>
<td>4</td>
<td>27</td>
<td>14.29</td>
<td>5.92</td>
</tr>
<tr>
<td>PNMT S5</td>
<td>6</td>
<td>26</td>
<td>14.77</td>
<td>5.51</td>
</tr>
</tbody>
</table>

N=35

Figure 3: PNMT Simple Design Learning Curve

R² = 0.8435
Table 4

PNMT Complex Designs – Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNMT S1</td>
<td>19</td>
<td>41</td>
<td>29.37</td>
<td>5.01</td>
</tr>
<tr>
<td>PNMT S2</td>
<td>17</td>
<td>39</td>
<td>26.94</td>
<td>5.84</td>
</tr>
<tr>
<td>PNMT S3</td>
<td>13</td>
<td>37</td>
<td>24.89</td>
<td>6.52</td>
</tr>
<tr>
<td>PNMT S4</td>
<td>20</td>
<td>34</td>
<td>23.03</td>
<td>6.45</td>
</tr>
<tr>
<td>PNMT S5</td>
<td>9</td>
<td>37</td>
<td>22.49</td>
<td>7.29</td>
</tr>
</tbody>
</table>

N=35

Figure 4: PNMT Complex Figure Learning Curve
3.3 Repeated measures ANOVA of PAYLP

A two-way 3 x 3 repeated measures analysis of variance (ANOVA) (PAYLP Learning [Trial 1 vs. Trial 2 vs. Trial 3] x Age Group [60-69 vs. 70-79 vs. 80+]) was conducted to assess the effects of age group and story presentation on performance. Results showed a significant main effect of PAYLP Learning, Wilks’ $\Lambda = .16$,

$F(2,31) = 83.423, \ p < .001, \ \eta^2 = .843$. Post-hoc pairwise comparisons revealed significant differences between learning on all of the trials with all values of $p < .001$. Individuals of all three age groups in general performed the best on Trial 3 of the PAYLP, in the middle on Trial 2 and the worst on Trial 1 of the PAYLP (see Table 5).

There was no significant interaction between PAYLP Learning and Age Group, Wilks’ $\Lambda = .899, F(4,62) = .849, \ p = .499, \ \eta^2 = .052$ as well as a nonsignificant main effect of Age Group, $F(2,32) = .688, \ p = .510, \ \eta^2 = .041$ (See Figure 5). Tukey HSD post-hoc pairwise comparisons revealed no significant differences between all age groups, with all values of $p > .05$. 
Table 5

PAYLP Learning Trials Performance by Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-69</td>
<td>13.35 (3.05)</td>
<td>18.07 (3.71)</td>
<td>21.36 (2.31)</td>
</tr>
<tr>
<td>70-79</td>
<td>11.60 (4.45)</td>
<td>16.73 (3.58)</td>
<td>18.93 (3.94)</td>
</tr>
<tr>
<td>80+</td>
<td>11.18 (3.82)</td>
<td>17.27 (3.90)</td>
<td>19.63 (3.38)</td>
</tr>
<tr>
<td>PAYLP Total**</td>
<td>12.51 (3.67)</td>
<td>17.71 (3.33)</td>
<td>20.25 (2.70)</td>
</tr>
</tbody>
</table>

Notes. Values are mean (SD). **(p<.001) indicates a significant main effect of PAYLP

Figure 5: PAYLP Learning Trials by Age Group
3.4 Paired samples t-tests of the three trials of PAYLP

Paired samples t-tests were conducted to investigate specific differences in performance on the three trial presentation. Results indicated that more items were significantly recalled in Trial 3 when compared to Trial 2, \( t(34) = 5.433, p < .001 \) and when Trial 3 was compared to Trial 1 \( t(34) = 12.93, p < .001 \). There was significantly more information recalled in Trial 2 when compared to Trial 1, \( t(34) = 10.10, p < .001 \). The results demonstrate that it is important to introduce the learning trials more than two times because significant learning still occurs between the second and third presentations (see Table 6).

**Table 6**

<table>
<thead>
<tr>
<th>Paired Differences between PAYLP Learning Trials</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>PAYLP 3-2</td>
<td>2.63</td>
</tr>
<tr>
<td>PAYLP 3-1</td>
<td>7.88</td>
</tr>
<tr>
<td>PAYLP 2-1</td>
<td>5.25</td>
</tr>
</tbody>
</table>

N=35
3.5 Correlation Analyses

3.5.1 Correlations for Age and Education with PAYLP

Nonparametric Spearman correlation coefficients were computed for the PAYLP with age and education to assess the relationship between demographic variables and assessment performance. There were no significant correlations between learning, interference, recall or recognition trials of the PAYLP and age. Additionally, the PAYLP measures did not significantly correlate with education (see Table 7).

Table 7

<table>
<thead>
<tr>
<th>Correlations for Age and Education with PAYLP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>PAYLP Trial 1</td>
</tr>
<tr>
<td>PAYLP Trial 2</td>
</tr>
<tr>
<td>PAYLP Trial 3</td>
</tr>
<tr>
<td>PAYLP Interference</td>
</tr>
<tr>
<td>PAYLP Immediate Recall Anna</td>
</tr>
<tr>
<td>PAYLP Delayed Recall Anna</td>
</tr>
<tr>
<td>PAYLP Delayed Recall Nancy</td>
</tr>
<tr>
<td>PAYLP Recognition</td>
</tr>
<tr>
<td>PAYLP Total Learning</td>
</tr>
<tr>
<td>PAYLP Trial 3 – Trail 2</td>
</tr>
</tbody>
</table>

N=35
3.5.2 Correlations for Age and Education with ROCF and PNMT

The ROCF and PNMT were also correlated with age and education using nonparametric Spearman correlation coefficients. There were no significant correlations between age or education with PNMT Learning or Delay trials. Besides the significant correlation between age and ROCF Copy, \( r = -.389 \), \( n = 35 \), \( p = .021 \), there were no significant correlations between age or education and the ROCF Copy, 3 Minute Delay, or 20 Minute Delay (see Table 8).

Table 8

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNMT Learning</td>
<td>.047</td>
<td>.055</td>
</tr>
<tr>
<td>PNMT Delay</td>
<td>.153</td>
<td>-.062</td>
</tr>
<tr>
<td>ROCF Copy</td>
<td>-.389*</td>
<td>.120</td>
</tr>
<tr>
<td>ROCF 3- minute delay</td>
<td>-.227</td>
<td>-.035</td>
</tr>
<tr>
<td>ROCF 20 minute delay</td>
<td>-.301</td>
<td>.032</td>
</tr>
</tbody>
</table>

N=35

*Correlation is significant at the .05 level (2-tailed)
3.5.3 Correlations for PAYLP Trial 1, PNMT Session 1, and ROCF Copy and 3 Minute Delay

Nonparametric Spearman correlation coefficients showed no significant correlations for the hypothesized WM measures, the first sessions of the PAYLP and PNMT and ROCF Copy and 3 Minute Delay (see Table 9).

Table 9
Correlations for PAYLP Trial 1, PNMT Session 1, and ROCF Copy and 3 Minute Delay

<table>
<thead>
<tr>
<th></th>
<th>PAYLP Trial 1</th>
<th>PNMT Session 1 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROCF Copy</td>
<td>.185</td>
<td>-.131</td>
</tr>
<tr>
<td>ROCF 3 minute delay</td>
<td>.183</td>
<td>-.060</td>
</tr>
<tr>
<td>PNMT Session 1 Total</td>
<td>-.224</td>
<td>---</td>
</tr>
</tbody>
</table>

N=35
3.5.4 Correlations for Delayed Recall of PAYLP, PNMT, and ROCF

When conducting nonparametric Spearman correlations for the verbal and nonverbal delay tasks, ROCF 20 Minute and PNMT Delay had a significant correlation, \( r = -0.408, n = 35, p = .015 \). There were no significant correlations between PAYLP Anna Thompson Delay and ROCF 20 Minute or PNMT Delay (see Table 10).

Table 10

Correlations for PAYLP Delayed Recall, PNMT Delayed Recall, and ROCF 20 Minute Delay

<table>
<thead>
<tr>
<th></th>
<th>PAYLP Delayed Recall Anna</th>
<th>PNMT Delayed Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROCF 20 minute delay</td>
<td>0.129</td>
<td>-0.408*</td>
</tr>
<tr>
<td>PNMT Delayed Recall</td>
<td>-0.229</td>
<td>---</td>
</tr>
</tbody>
</table>

N=35

* Correlation is significant at the .05 level (2-tailed)
Overall, the hypotheses of this study were partially supported. The PAYLP exhibited a positive learning curve throughout three trial presentation. The hypothesis regarding the importance of three trial presentation was also supported due to individuals remembering significantly more information about the story after the third presentation in comparison to the second. The lack of significant correlations between PAYLP performance and age and education contradict previous research findings supporting relationships between younger age and higher education on memory performance (Abikoff et al., 1987). Additionally, the lack of significant correlations between Trial 1 of the PAYLP, Session 1 of PNMT, and ROCF Copy and 3 Minute Delay tasks do not support the hypothesis that Trial 1 of the PAYLP may be a measure of WM.

4.1 Implications

The results of the two-way repeated measures ANOVA suggest that significant learning for prose memory occurs with multiple trial presentations of a story. Prose memory assessments that only present a story one time may not be measuring true
learning abilities. Because individuals remembered significantly more information on Trial 3 of the PAYLP in comparison to Trial 1, this shows that intact encoding and retrieval processes have some dependence on the amount of times stimuli are presented. This can be supported by the findings on other verbal memory assessments, such as the Rey-Auditory Verbal Learning Test (RAVLT) in which normative data demonstrates that more words from the list on Trial 5 are remembered in comparison to Trial 1 (Johnstone, et al., 2000). When individuals present a positive learning curve with multiple trial presentation, they are demonstrating that the information is not only encoded and stored into LTM but is also learned and comprehended.

Additionally, the significance of the independent sample $t$-test when comparing performance on Trial 2 and Trial 3 of the PAYLP suggest that individuals learn more information about a story with three trial presentation in comparison to only two trials. Repetition of stimuli is a component to the process of learning that occurs during memory task performance.

The lack of significant correlations between PAYLP Trial 1, PNMT Session 1, and ROCF Copy and 3 Minute Delay suggest that Trial 1 of the PAYLP may not be as strong of an indicator of WM as originally predicted. Utilizing another verbal assessment in substitution of nonverbal measures, such as the RAVLT and comparing the first trial performance to that of the PAYLP may provide better insight as to whether Trial 1 assesses for WM or not.

Lastly, the nonsignificant correlations between age and education on memory performance suggest that the current population may have been too small and/or too homogenous. Although there were no significant correlations with PAYLP and age,
there are trends in the negative direction, which coincides with the prediction that younger individuals have better memory performance than older adults. This can also be reflected in the trending positive correlations the PAYLP had with education in which those with more education generally have better prose memory performance. The findings from the Lee et al. (2004) study had significant differences on prose memory performance in high and low educated older adults. But, their study had a much larger range of education (no formal education to about a university level education) differences than the current study (11 to 20 years of education). Similarly Abikoff et al. (1987)’s normative study was a much larger sample (N=339) with individuals ranging from 6 years of formal education to 18 years. Expanding the sample age and education ranges for future research may assist in creating a more heterogeneous sample and increase variability that may aid in the significance of these correlations.

4.2 Limitations

Research suggests that individuals enhance their performance on prose memory tasks by adding previous and related knowledge (Dooling & Christiaansen, 1977). Dooling and Christiaansen (1977) reported that individuals with similar experiences to the provided material may have a schema for that information and may be able to retrieve it more easily when compared to an unfamiliar story. For example, an individual who knows a person named Anna or who has lived in Chicago may be able to retrieve that information more successfully than one who has not created schemas for those people or places. This capability allows the individual to recall specific details of the story, such as the specific name “Anna” or city of “Chicago” versus remembering that the main
character in the story was a woman or that she was from the Midwest. Dooling and Christiaansen (1977) describe this capability as a person having extraexperimental knowledge that is present at initial encoding and retrieval processes of the assessment and aids in LTM storage. Future research may include a supplemental questionnaire asking if the participant had similar experiences to the stories. This information may help differentiate between individuals who have extraexperimental knowledge and those who are encountering novel information and developing new schemas. Obtaining this information may then allow researchers to analyze the various processes involving new memories for stories versus previously learned material.

The lack of relationship between age and education on prose memory performance indicates that there are still inconsistencies regarding the norms of this test. Lichtenberg and Christensen (1992) conducted a study that found no significant correlations between age and education on Logical Memory task performance. This suggests that this aspect of memory assessment still needs future research conducted.

Due to the preliminary nature of this study, the small sample size may not allow the results of this study to be generalizeable to the overall population. Additionally, the strict cutoff screening tool used, the MoCA eliminated (n=4) individuals from participating in the study. The already small sample size was reduced and therefore makes it difficult to generalize to the population of normally aging adults. This limitation became apparent when assessing the correlations between age and education on memory performance. Future research may strive to collect a more heterogenous and larger sample size.
The hypothesis of this study predicting the importance of three trial story presentation and the presence of a positive learning curve may further be supported by assessing individuals with dementia or brain injury, specifically hippocampal or frontal lobe atrophy. Future research on the validation of this prose memory assessment would require a comparison of performance between a normal control group and those with preexisting hippocampal or frontal lobe atrophy. The comparison between these two groups would analyze the efficacy of this prose memory assessment in differentiating between specific memory deficits such as encoding, retrieval, and consolidation deficits.
References


Athens, GA: Artificial Intelligence Center.


