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Pre-Test Experience and Memory Performance in Older Adults: The Impact of Test Anxiety and Self-Efficacy

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Abstract

Objective: The objective of this paper is to investigate the role of test anxiety and memory self-efficacy on memory performances in older adults.
Method: One hundred cognitively normal, community-dwelling older adults aged 65+ participated used in this experimental study. Participants completed baseline evaluations (including pre-test anxiety) prior to being assigned to one of two experimental conditions in which they experienced either success or failure on a verbal test. They subsequently completed post-test anxiety ratings, a measure of memory self-efficacy (Memory Self-Efficacy Questionnaire), and standardized tasks of working memory and verbal episodic memory.
Results: Following experimental manipulation, participants in the pre-test failure condition demonstrated higher anxiety and lower memory performances. Hierarchical regression revealed that change in anxiety from pre-test to post-test predicted memory performances and mediation analyses demonstrated that these effects were explained by lower memory self-efficacy.
Conclusions: For older adults, experiencing test failure prior to memory testing may result in increased test anxiety and lower memory self-efficacy leading to poorer memory performance. This has implications for diagnostic cognitive assessment for older people.

Keywords: Memory; Aging; Older adults; Self-efficacy; Test anxiety; Cognitive; Neuropsychological

Background

In many societies today, the proportion of older people in the community is increasing (World Health Organisation [WHO], 2018), and maintaining independence into older age is as dependent on cognitive health as on physical status (Kelley, Ulin, and McGuire, 2018; Park & Festini, 2017). A commonly reported cognitive change in older age relates to memory performance (Slavin et al., 2010), and the everyday impact can be as varied as creating dependence in managing a home-based medication regime or forgetting to collect dry-cleaning on the way home. Memory changes are of concern to older people because they can frequently present as the early marker of the degenerative changes associated with dementia, typically Alzheimer's disease (Petersen et al., 2018; Pike & Kinsella, 2019). As a result, it is not uncommon for older people to seek reassurance through a diagnostic neuropsychological assessment.

Queries about the differential diagnosis of dementia are commonly referred to as specialist clinics, or memory clinics (Mastwyk, Dow, Ellis, and Ames, 2016). These services are generally multi-professional, including neuropsychologists, as it is recognized that cognitive changes in older age can reflect multiple causes, including neurological and psychiatric disorders. In this respect, anxiety is known to impact memory performance (Lukasik, Waris, Soveri, Lehtonen, and Laine, 2019; Williams et al., 2017) and is a risk factor for emergent dementia and also progression (Li & Li, 2018). Complicating this issue is that anxiety about undertaking neuropsychological tests (i.e., test anxiety) can impact negatively on cognitive performance, as indicated by

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a recent systematic review of studies using participants across the lifespan (Dorenkamp & Vik, 2018). The combination of these findings highlights the complexity of interpreting neuropsychological test performance in older people with noted anxiety about memory performance. Therefore, understanding how anxiety impacts memory performance in older age, especially within test situations, is important for neuropsychologists when engaged in the differential diagnosis of potential early dementia.

A further issue that needs to be considered in evaluating older adults is that many hold negative stereotypes about cognitive aging, resulting in the expectation of poor performance on memory tests (Hahn & Lachman, 2015). Recent meta-analyses have demonstrated that experimentally manipulating, or activating, negative aging stereotypes before a memory experiment, can significantly reduce memory test performance of older age participants (Armstrong, Gallant, Li, Patel, & Wong, 2017; Lamont, Swift, & Abrams, 2015). This has been referred to as stereotype threat and can be apparent within explicit or implicit conditions in experimental situations. For example, explicitly telling older participants that younger age people tend to perform better on a memory test; or implicitly, by informing older age participants that their performance will be compared to younger age participants (Armstrong et al., 2017; Haslam et al., 2012). Less studied is whether the powerful influence of negative aging stereotypes on memory performance can be minimized, or even reversed, by increasing self-confidence in memory ability. This is highly relevant to neuropsychologists as a goal in assessment is to observe test performance under optimum conditions as much as documenting impaired performance in situations and tasks that are challenging (Lezak, Howieson, Bigler, & Tranel, 2012).

In an early experimental study, Geraci and Miller (2013) investigated the impact of prior task experience on subsequent memory performance. The concept being addressed was whether providing older age participants with experience of success in a task, before a memory test, would reduce negative expectations for the memory test and improve memory performance. Participants were allocated to different conditions in which they were provided with a cognitive task that they could either complete successfully or not, and then undertook a memory test. The researchers found that older adults in the prior task success condition performed better on the memory test, and self-reported anxiety was lower. This positive finding suggested the possibility that a simple manipulation could be introduced into the clinical assessment of older adults in order to observe memory test performance under optimal conditions.

However, the mechanism by which these results occurred was not explicitly tested and needs further clarification. Geraci and Miller (2013) interpreted their positive findings in terms of enabling a reduction in test anxiety in the participants, but they also acknowledged that by measuring test anxiety only after the memory test, rather than pre- and post-experimental manipulation, their results could not be confidently related to prior task success. Indeed, actual performance on the memory test might have been a major contributor to test anxiety. Furthermore, in a later study, Geraci, Hughes, Miller, and De Forrest (2016) were unable to replicate their finding that anxiety was lower following prior task success. Therefore, the role of anxiety in the relationship between prior task experience and memory test performance needs further exploration.

Bandura (1994) proposed that real-life successes increase positive self-efficacy expectations, decrease anxiety, and influence task performance. More specifically, the relationship between self-efficacy and memory test performance has been observed in a general adult sample, whereby more stable self-efficacy is associated with better performance on challenging memory tasks (Agrigoroaei, Neupert, & Lachman, 2013). This suggests that using self-efficacy in a mediational model may offer further information about a potential relationship between manipulated anxiety and memory test performance.

The aim of the current study is to extend the previous findings of Geraci and colleagues (2013, 2016) by manipulating pre-test experience (task success or failure) and clarifying the impact of anxiety on subsequent memory test performance. In addition, the study investigated a potential mediating role of self-efficacy. To facilitate the translation of the research findings to the clinical setting, memory performance was assessed through standard neuropsychological tests rather than experimental memory measures. Also, to ensure that the manipulation effects were not task specific, two memory domains were assessed—episodic memory and working memory. It was expected that in a sample of older age participants there would be a direct effect of pre-test experience (success or failure) on memory performance (episodic memory, working memory); after a pre-test task, there would be a direct effect of change in anxiety on memory performance, such that pre-test success would result in decreased anxiety and better memory performance, while pre-test failure would result in increased anxiety and lower memory performance; and, this effect would be mediated by self-efficacy. Our objective was to provide further understanding of the mechanisms that promote or challenge neuropsychological test performance in older adults.

Method

Design

The current study investigated the influence of pre-test experience on subsequent memory performance (i.e., episodic memory and working memory), and the contribution of test anxiety and self-efficacy on memory performance. Participants were randomly allocated into one of two experimental groups (pre-test success or failure). Anxiety and self-efficacy were assessed, and neuropsychological measures of episodic and working memory were administered.

Participants

One hundred community-dwelling, older age participants were recruited via community groups and networks in Melbourne and regional Victoria. Participants were eligible if they met the following inclusion criteria: aged 65 years or above; sufficiently fluent in English to complete questionnaires and understand informed consent procedures; absence of self-reported neurological or psychiatric disorders; and absence of low cognitive status as indicated by a score of 15 or lower on a cognitive screen (The TELE; Gatz et al., 1995). Exclusions included individuals with self-reported emotional distress as evidenced by a score in the severe range on a measure of emotional status (the Depression, Anxiety and Stress Scale; Lovibond & Lovibond, 1995).

Measures

Experimental Condition

Pre-test experience: The sentence scramble task (Geraci & Miller, 2013). In order to manipulate pre-test experience, the sentence scramble task was presented to participants as a simple language task. The task contained a list of 30 scrambled five-word sequences. Participants were required to create grammatically correct four-word sentences from the five words provided (e.g., lamp, the, fell, run, over: the lamp fell over). The task was presented in one of two conditions. In the pre-test success condition, participants had unlimited time to complete the task. Pilot testing conducted by Geraci and Miller (2013) demonstrated that older adults in this condition could correctly unscramble 97% of the sentences. In the pre-test failure condition, participants were required to complete the same task, but within a constrained time-limit (10 s per sentence). Using this timing, Geraci and Miller (2013) reported that only 43% of sentences were completed by older age participants. In this manner, this task was manipulated to provide an experience of task success or task failure.

Memory Outcome Measures

The Rey Auditory Verbal Learning Test (RAVLT; Schmidt, 1996). The RAVLT assesses episodic verbal memory and learning and consists of a 15-item word-list with five learning trials. Participants were asked to recall as many words as possible after each learning trial. Subsequently, there is an interference word-list of 15-items with participants asked to recall as many words as possible from the second list, and then recall the original list without another presentation. After a delay of 20–25 min, the participants were asked to recall the first list of words again in a delayed recall trial. The number of words recalled in the delayed recall (RAVLT DR) trial was used in the current study as an index of episodic memory performance.

Backward digit span (BDS; Wechsler, 2008). The Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) BDS provided an index of working memory. The examiner reads the participant a string of digits which increases in length every second trial, and the participant is asked to repeat each string in backward order. The number of correct trials was used as the performance measure. As BDS was used in this experimental study as the measure of working memory (following standard administration of forward digit span), subsequent administration of digit span sequencing (as per WAIS-IV protocol for clinical assessment) was not conducted.

Predictors

Pre- and post-test Anxiety rating Questionnaire (Geraci & Miller, 2013). To derive pre-test anxiety levels, participants were asked to rate the extent to which they agreed with the statement “I feel anxious about my testing performance undertaking the upcoming tasks” on a 7-point Likert scale (ranging from 1 = strongly disagree to 7 = strongly agree). To derive post-test anxiety levels, following completion of the experimental task, participants were asked to rate the extent to which they agreed with the statement “I felt anxious about my performance undertaking the previous tasks” on a 7-point Likert scale (ranging from 1 = strongly disagree to 7 = strongly agree). An anxiety change score was derived by subtracting pre-test anxiety from post-test anxiety to indicate the degree to which there was a change in test anxiety rating following the experimental condition.

The memory self-efficacy Questionnaire (Berry, West, & Dennehey, 1989). A modified version of the memory self-efficacy questionnaire (MSEQ) was used to measure self-efficacy for memory performance. The original 50-item MSEQ addresses 10 different aspects of memory. For the purpose of this current study, only the 11 items relating to episodic memory and digit recall were included, as it has been reported that self-efficacy measures that directly correspond with a subsequent memory task demonstrate superior reliability (Berry et al., 1989). Participants rated their memory abilities on these 11 items, for example, "If I heard it five times, I could remember a list of eight numbers without any assistance." Participants then rated their confidence in their response, on a scale of 10%–100%. In this manner, two measures of self-efficacy were derived, self-efficacy level and self-efficacy strength. Self-efficacy level was calculated by summing the "yes" responses, whilst self-efficacy strength was calculated by averaging the confidence rating scores across the positively endorsed responses. For the purposes of this research, only self-efficacy strength was used within analyses, as it has previously been shown to be a more indicative measure of true self-efficacy and significantly related to memory performance (Berry et al., 1989).

Procedure

Potential participants were contacted and screened for inclusion and exclusion criteria. If suitable, participants were randomly allocated to one of the two conditions (pre-test success, pre-test failure) through computer-generated randomization codes. The research was approved by the La Trobe University, Humans Ethics Committee (FHEC 14/R55), and all participants provided written informed consent prior to participation.

A demographic questionnaire and the DASS-21 were posted to participants after telephone screening and brought to the assessment session already completed. In the assessment session (approximately 60 min long), participants completed tests in the following order: Test of Premorbid Function (TOPF; Wechsler, 2009) a measure of general cognitive reserve, and Prose Passages, a measure of baseline memory performance (Foldi, 2011). Pre-test anxiety was also assessed prior to the experimental task manipulation. Following the experimental task, participants completed the post-test anxiety rating and a self-efficacy rating. Lastly, approximately 20 min after the assessment of pre-test anxiety, participants were asked to complete the memory tests (RAVLT and BDS).

Statistical Method

All assumption testing, data screening and analyses were conducted following preliminary data entry using the Statistical Package for the Social Sciences, version 22. The dataset containing all 100 participants was screened and absent of any missing values or outliers on the main outcome variables. The internal consistency of the modified MSEQ was deemed satisfactory in order to derive self-efficacy strength (Cronbach's $\alpha = .83$).

To ensure that there were no significant differences between groups on key demographic variables (age, gender, and years of education), TOPF, prose passages, and baseline anxiety ratings, t-tests or chi-square were conducted as a manipulation check. Additionally, a one-way MANOVA was conducted on the two dependent measures of memory performance (RAVLT DR and BDS), to demonstrate any significant group differences following the experimental condition.

Prior to the analysis of inferential statistics, normality was assessed by skewness and kurtosis values. All variables were within normality boundaries ($z = \pm 3.30$) except for baseline anxiety, which was transformed using a square-root transformation (denoted with superscript SQ; Tabachnick & Fidell, 2013). For MANOVA procedures, partial eta-squared ($\eta_p{}^2$) was employed as a measure of effect size, with interpretations of results based on Cohen's criteria of small (.01), medium (.06), and large effect sizes (.14; Tabachnick & Fidell, 2013).

For each dependent variable (RAVLT DR, BDS), hierarchical regression was used to determine whether a decrease in anxiety following pre-test success predicted memory performances. After accounting for covariates in Step 1 (age, gender, and TOPF), baseline anxiety in Step 2, anxiety change was added to the model in Step 3. Subsequently, a bootstrapping mediation analysis using PROCESS was conducted to determine whether self-efficacy mediated the effect of anxiety change on memory performances (Hayes, 2017). A bias-corrected bootstrapping method evaluated the indirect effects by producing 95% confidence intervals based on 10,000 bootstrapped samples (Mackinnon, Lockwood, and Williams, 2004; Preacher & Hayes, 2008). A confidence interval that did not cross zero was considered statistically significant for the mediation (i.e., indirect) effect.

Results

Sample Characteristics

A total of 100 older adults aged 65–98 years participated ($M = 77.14$, $SD = 7.92$), with 46 males and 54 females. Years of education ranged from 3 to 16 years ($M = 10.60$, $SD = 3.44$). Through random allocation, 49 participants formed the pre-test

Table 1. Means and standard deviations for demographics and baseline scores according to experimental condition

Variable	Pre-test success ($n = 49$)		Pre-test failure ($n = 51$)	
	M/Mdn	*SD*/IQR	*M/Mdn*	*SD*/IQR
Age	77.43	8.41	76.86	7.48
Years education	10.53	3.89	10.67	2.97
Gender (%F)	53.1		54.9	
TOPF score	108.80	7.82	106.86	9.83
Prose passage score	8.20	4.31	7.45	4.21
Baseline anxiety^{SQ}	2.00	1.50	2.00	2.00

Note: ^{SQ} = square-root transformed; therefore, Mdn (median) and IQR (interquartile range) reported in table.

Table 2. Mean and standard deviations for RAVLT delayed recall and backward digit span following each pre-test experience condition

	Pre-test success ($n = 49$)		Pre-test failure ($n = 51$)		η_p^2
	M	*SD*	*M*	*SD*	
RAVLT DR	8.31	2.51	6.10	2.38	.17
BDS	8.24	1.89	6.22	2.19	.20

Note. BDS = backward digit span; RAVLT DR = Rey Auditory Verbal Learning Test Delayed Recall; η_p^2 = partial eta-squared.

success group and 51 participants formed the pre-test failure group. A manipulation check to test the efficacy of randomization on creating balanced groups demonstrated no significant difference between experimental groups on baseline characteristics including age, years of education, TOPF, prose passage score, and baseline anxiety rating (*ps* > .05; see Table 1). Similarly, a chi-square test for independence did not demonstrate a significant association between experimental condition and gender χ^2 (1, $n = 100$) = .34, $p = .854$. Therefore, randomization was considered successful.

The Impact of Pre-Test Success or Failure on Memory Performance and Anxiety

To evaluate the first hypothesis that pre-test experience will directly impact on memory performances, a one-way MANOVA was conducted to compare groups (pre-test success, pre-test failure) on RAVLT DR and BDS. Results demonstrate a significant group difference on the combined dependent variables F (2,97) = 14.38, $p < .001$, with a large effect $\eta_p{}^2 = .23$ (see Table 2 for means, standard deviations, and effect size on memory outcomes). Separate univariate analyses with a Bonferroni-adjusted α of .050/2 demonstrated older adults in the pre-test success condition performed significantly better than older adults in the pre-test failure condition, for both RAVLT DR $F(1,98) = 20.25$, $p < .001$, with a large effect $\eta_p{}^2 = .17$, and BDS, $F(1,98) = 24.50$, $p < .001$, with a large effect $\eta_p{}^2 = .20$.

To evaluate the second hypothesis and determine whether pre-test experience impacted on anxiety, a 2 × 2 mixed model ANOVA was conducted (pre-test success/failure group) × (pre/post anxiety rating). Because pre-test anxiety was skewed a square-root transformation was applied to both pre-test and post-test anxiety. Results indicated a significant interaction F (2,97) = 108.20, $p < .001$, with a large effect $\eta_p{}^2 = .53$, indicating that anxiety changed differentially across the groups. Post-hoc analyses using separate univariate analyses with a Bonferroni-adjusted α of .050/2, demonstrated that for the pre-test success group, there was no significant change in anxiety before and after testing F (1,48) = 0.13, $p = .725$, with a small effect $\eta_p{}^2 = .003$. In contrast, for the pre-test failure group, there was a significant increase in anxiety post-testing F (1,50) = 138.06, $p < .001$, with a large effect $\eta_p{}^2 = .734$.

Prediction of Memory Performances

To determine whether memory performances following experimental manipulation were accounted for by change in memory test anxiety, two hierarchical regressions were conducted.

Episodic Memory Performance. For RAVLT DR, in Step 1, age, gender, and TOPF did not account for significant variance in performance (i.e., 0.2% of the variance), $R^2 = .02$, $F(3, 96) = 0.56$, $p = .643$. In Step 2, baseline anxiety did not account for significant variance in performance (i.e., an additional 0.34%), $\Delta R^2 = .03$, $\Delta F(1, 95) = 3.42$, $p = .068$. In contrast, in Step 3,

Table 3. Summary of hierarchical regression analyses for demographic variables, pre-test anxiety, and anxiety change predicting episodic memory and working memory

Dependent variable	Predictor block[a]	Change statistics		Overall model						
		ΔR^2	ΔF	Predictors	β	*sr*	*r*	R^2	*df*	*F*
RAVLT delayed recall	Demographics	.02	.56	Age	−.10	−.10	−.10	.02	(3, 96)	0.56
				Gender (F)	.06	.06	.06			
				TOPF	.07	.07	.06			
	Pre-test anxiety	.03	3.42	Pre-test anxiety	−.19	−.19	−.17	.05	(1, 95)	1.29
	Anxiety change score	.29	41.82***	Anxiety change score	−.58***	−.54	−.43	.34	(1, 94)	9.83***
Backward Digit Span	Demographics	.13	4.65**	Age	−.12	−.12	−.10	.13	(3, 96)	4.65**
				Gender (F)	.08	.08	.05			
				TOPF	.34**	.34	.33			
	Pre-test anxiety	<.01	0.20	Pre-test anxiety	−.04	−.04	−.01	.13	(1, 95)	3.51*
	Anxiety change score	.28	44.77***	Anxiety change score	−.57***	−.53	−.49	.41	(1, 94)	13.05***

Δ = change statistics; β = standardized beta; *sr* = semipartial correlation; TOPF = test of premorbid function; **p* < .05, ***p* < .01, ****p* < .001. a = For each dependent variable, the first block shows the contribution of demographics, the second block shows the additional contribution of pre-test anxiety, and the third block shows the additional contribution of anxiety change score after accounting for the previous two blocks.

anxiety change accounted for significant variance in performance (i.e., an additional 29.2%), $\Delta R^2 = .29$, $\Delta F(1, 94) = 41.82$, $p < .001$. (see Table 3).

Working Memory Performance. For BDS, in Step 1, age, gender, and TOPF accounted for 12.7% of the variance in performance, $R^2 = .13$, $F(3, 96) = 0.56$, $p = .004$, with better performance associated with higher TOPF ($sr = .34$, $p = .001$). In Step 2, baseline anxiety did not account for additional significant variance in BDS performance (i.e., an additional 0.2%), $\Delta R^2 < .01$, $\Delta F(1, 95) = 0.20$, $p = .657$, but similar to RAVLT DR, in Step 3, anxiety change score accounted for significant variance in BDS performance (i.e., an additional 28.1%), $\Delta R^2 = .28$, $\Delta F(1, 94) = 44.77$, $p < .001$. (see Table 3).

In both regressions, a greater increase in anxiety after task manipulation was predictive of poorer memory performance.

Mediation Analysis

To test whether self-efficacy mediated the effect of anxiety change on memory performances, mediation analysis was conducted.

Episodic Memory Performance. After including self-efficacy as a mediator, the direct effect of change in anxiety on RAVLT DR was not significant (95% CI [−0.53, 0.03]), and the bias-corrected bootstrapped confidence intervals for the indirect effect indicated that self-efficacy mediated the direct effect ($b = -.25$, 95% CI [−0.38, −0.16]; see Fig. 1).

Working Memory Performance. Similarly, after including self-efficacy as a mediator, the direct effect of change in anxiety on BDS was not significant (95% CI [−0.40, 0.02]), and the bias-corrected bootstrapped confidence intervals for the indirect effect indicated that self-efficacy mediated the direct effect ($b = -.33$, 95% CI [−0.45, −0.22]; see Fig. 2).

In both mediation analyses, increased anxiety led to lower self-efficacy which was associated with lower memory performance.

Discussion

This study initially examined how pre-test experience can impact memory performance in older people. As expected, pre-test experience (success or failure) impacted subsequent memory test performance, such that pre-test success was associated with better memory performance and pre-test failure with lower memory performance. However, the findings also clarify previous research by demonstrating the mechanisms through which this occurs. This effect appeared to be associated with an increase in test anxiety following the experience of pre-test failure, rather than a decrease in anxiety following pre-test success. The change in

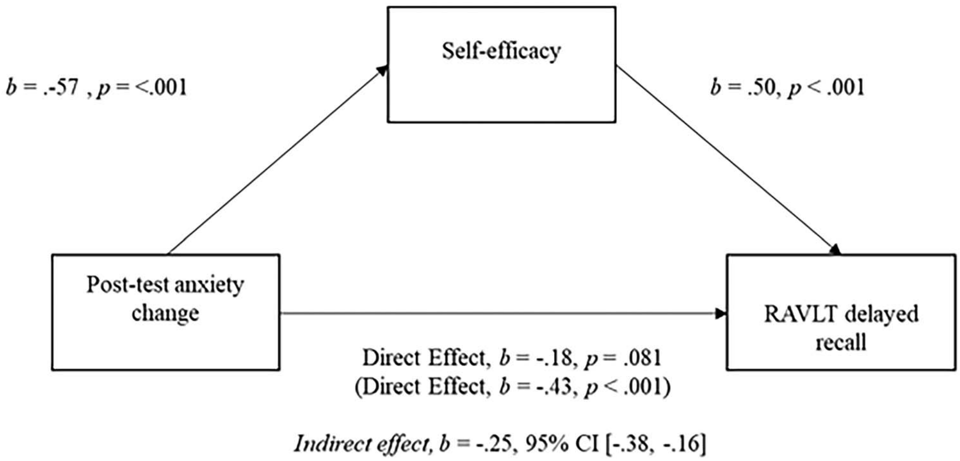

Fig. 1. Mediation analysis using post-test anxiety change as the independent variable, self-efficacy as the mediator, and RAVLT DR as the dependent variable. Notes: path coefficients are standardized beta coefficients from regression analyses. The direct effect in parentheses refers to the effect of post-test anxiety change on RAVLT DR prior to the inclusion of the mediator.

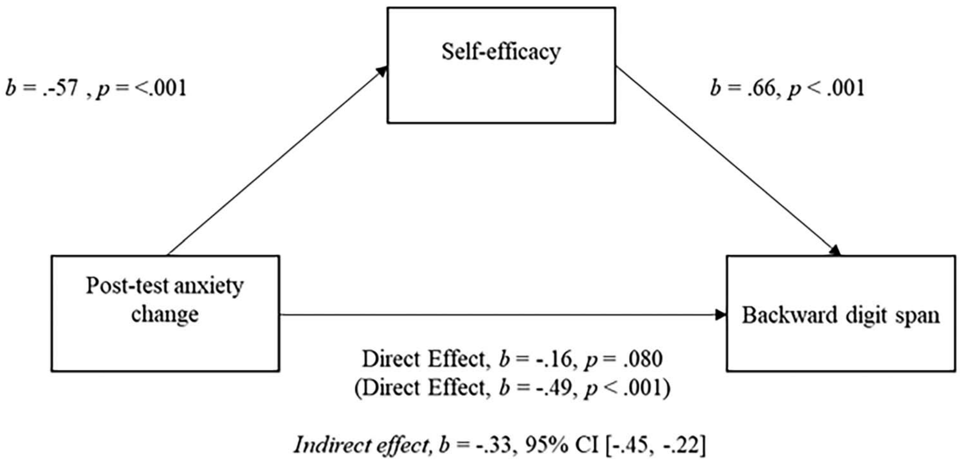

Fig. 2. Mediation analysis using post-test anxiety change as the independent variable, self-efficacy as the mediator, and BDS as the dependent variable. Notes: path coefficients are standardized beta coefficients from regression analyses. The direct effect in parentheses refers to the effect of post-test anxiety change on BDS prior to the inclusion of the mediator.

anxiety following the pre-test condition predicted subsequent episodic and working memory performances. Moreover, the effect of increased anxiety on poorer memory performance was mediated by self-efficacy. That is, the increased anxiety associated with the experience of pre-test failure, negatively impacted memory test performance by decreasing older adults' sense of belief in their ability to successfully undertake a memory test.

These findings converge with previous research showing that older adults' memory performances can be manipulated through general prior experience, for example, activating negative ageing stereotypes (i.e., stereotype threat) can reduce older adults' performance on subsequent memory tasks (Armstrong et al., 2017; Lamont et al., 2015). These experiences lead to expectations that influence actual memory performance, including those externally imposed, such as providing negative ageing stereotypes (Bouazzaoui et al., 2016; Haslam et al., 2012), or those that are internally generated, such as demonstrated in the current study and previously by Geraci & Miller (2013). While these researchers interpreted their positive findings of pre-test success resulting in better performance due to a lowering of anxiety, in the current study we measured the assumption of anxiety change directly by measuring anxiety pre- and post-experimental manipulation. In this manner, we found that it was the experience of pre-test failure that resulted in higher anxiety (rather than pre-test success resulting in lower anxiety). Recent large public health campaigns have emphasized healthy ageing, with many older people today (baby boomers) approaching old age proactively which is associated with resilience and acceptance in ageing (Wilhelm, Geerligs & Peisah, 2014). Therefore, in our healthy older adult sample, without expectation of memory difficulty, the experience of test failure may have been unexpected and more disruptive than the condition of task success which simply confirmed their expectation of memory ability. This interpretation of the current data is supported by the finding that baseline test anxiety did not predict performance on either task.

The current findings also relate to previous literature that highlights the impact of order of test administration on test performance in terms of interference effects (e.g., Lloyd, Higginson, Lating, & Coiro, 2012; Laurie-Rose, Frey, Sibata, & Zamary, 2015; Franzen, Smith, Paul, & MacInnes, 1993). While neuropsychologists may routinely consider order effects in relation to task interference, our findings suggest that further consideration should also be given to the order of test administration in terms of likelihood of success or failure and the effect that this may have on change in anxiety and self-efficacy. In any performance domain, low self-efficacy is proposed to be associated with poorer performance, lower motivation to complete the task, lower personal performance goals, less perseverance when faced with difficulty, and higher task anxiety (Bandura, 1989). More specifically, the relation between low memory self-efficacy with poorer memory performance has been reported through a meta-analysis of adult and young adult samples (Beaudoin & Desrichard, 2011). Our work extends these previous findings by demonstrating that for older adults, a cause of lower memory self-efficacy need not be as explicit as exposure to negative ageing stereotypes (Bouazzaoui et al, 2016), but can result from simply experiencing test failure within an assessment. Therefore, the negative impact on memory performance can result from the assessment situation through increasing anxiety and decreasing self-efficacy and needs careful consideration in the assessment setting.

The current study is important in the context of clinical assessment, where anxiety and low memory self-efficacy can influence test performance and has implications for differential diagnosis. Many older people report anxiety prior to neuropsychological assessment, particularly if presenting after experiencing everyday memory difficulties, and are frequently concerned about early signs of dementia (Kessler, Südhof, & Frölich, 2014; Mastwyk et al., 2016). In such a situation, it is important to minimize test anxiety as a significant contributor to poor neuropsychological test results. Therefore, mitigating the effect of test anxiety and poor memory self-efficacy by ensuring patients experience test success in the initial stage of the assessment, and/or immediately prior to memory testing, will assist in evaluating “best-effort” performance. In this regard, it may be useful to consider existing literature that aims to ameliorate the impact of stereotype threat and anxiety on cognitive performance in a general adult population. For example, it has been found that by simply informing participants about the negative impact of stereotype threat (in this case women and mathematics), it is possible to improve participants’ performances (Johns et al., 2005). Alternatively, a brief mindfulness exercise undertaken prior to testing has been associated with better mathematics performance in women exposed to stereotype threat (Weger et al., 2012), and better episodic memory performance in undergraduates (Brown, Goodman, Ryan, & Anālayo, 2016). As these interventions would all be manageable within the context of a diagnostic cognitive assessment, further research could explore whether similar approaches may mitigate against the effect of pre-test failure on subsequent memory performance in older people.

Strength, Limitations, and Directions for Future Research

The strengths of this study include the direct measurement of change in anxiety post manipulation, the assessment of self-efficacy, and the use of a mediation model that allowed us to demonstrate the mechanism through which pre-test failure resulted in reduced memory performance. The large sample size was also an advantage of this study. The limitations of this research were that we did not have a younger aged comparison group. Therefore, it is not possible to say whether the effect of pre-test experience on subsequent memory performance is specific to older people, or can be generalized across age groups. In addition, it is possible that the experience of test failure resulted in other effects not measured by this study, for example, frustration, reduced motivation, and disengagement from the assessment. While we used a timed task to generate the experience of success versus failure, it is unclear whether other experiences of test failure would have similar effects (e.g., task difficulty as opposed to time pressure). These aspects might be better explored in future research by interviewing participants after the study to explore their subjective experiences. To better explore possible bidirectional relationships between test anxiety and memory self-efficacy, it would also be useful for future studies to include pre- and post-measures of memory self-efficacy. Another limitation is that our measure of test anxiety was based on a single question pre- and post-manipulation. Finally, it must be acknowledged that this sample was a community-based sample of older adults who were not seeking cognitive assessment for differential diagnosis of dementia. Future research should, therefore, replicate the findings in clinical samples of older adults who are seeking cognitive assessment, and with potentially high levels of comorbid anxiety. In addition, it will be critical to establish whether intervention strategies, that can be easily introduced within a cognitive assessment, are effective in minimizing the impact of test failure.

Conclusions

The experience of pre-test failure and subsequent increased anxiety can lead to poorer memory test performances in older adults due to a decrease in self-efficacy. Clinicians conducting diagnostic memory testing and wishing to include observations under optimum conditions as well as under challenging conditions may need to ensure test success is experienced prior to memory testing in order to mitigate the effect of test anxiety and to obtain the best performance.

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Conflicts of Interest

The authors have no conflict of interest.

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