



## Late life anxiety is associated with decreased memory and executive functioning in community dwelling older adults

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### ABSTRACT

This study assessed the degree to which anxiety and depression symptoms are associated with memory and executive functioning among community-dwelling older adults ( $N = 120$ ;  $M$  age = 74.9 years,  $SD = 7.2$  years; 62% women). Participants completed the Geriatric Anxiety Scale, Geriatric Depression Scale, Comorbidity Index, California Verbal Learning Test, Second Edition (CVLT-II), and the Trail Making, Verbal Fluency, and 20 Questions subtests of the Delis–Kaplan Executive Function System (D–KEFS). Multiple regression analyses indicated that anxiety and depression predicted poorer ability to learn new information (CVLT-II, Trials 1–5). Both anxiety and depression predicted performance on the D–KEFS Trail Making test, Number–Letter Switching condition. Anxiety, but not depression, predicted decreased categorization as measured by the D–KEFS 20 Questions, Initial Abstraction Score. Depression but not anxiety, predicted performance on D–KEFS Letter Fluency and Category Fluency. Findings suggest that anxiety and depression have unique relationships with cognitive functioning in community-dwelling older adults.

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Anxiety is among the most ubiquitous and debilitating mental health problems in older adults. In fact, diagnosable anxiety disorders in this population are common, with a prevalence estimate ranging up to 15.3% (Bryant, Jackson, & Ames, 2008; Kessler et al., 2005). Sub-syndromal anxiety symptoms are even more widespread than anxiety disorders, with prevalence ranging from 15% to 52.3% in community samples (Bryant et al., 2008). Anxiety can be considered to have several components: physical or somatic symptoms (i.e., racing heart, sleep trouble), affective symptoms (i.e., feeling keyed up or on edge), and cognitive symptoms (i.e., worry that is difficult to manage) (Segal, Qualls, & Smyer, 2011). Anxiety is associated with a multitude of dire outcomes in late life, such as depression, urinary incontinence, sleep disturbances, mortality, and diverse unhealthy behaviors such as smoking, physical inactivity, poor diet, and alcohol abuse (Mehta et al., 2003; Strine, Chapman, Kobau, & Balluz, 2005; van Hout et al., 2004). Despite the number of adults in later life impacted by this condition, anxiety and negative affect are generally less prevalent in older adults than in younger adults (Caspi, Roberts, & Shiner, 2005; Charles, Reynolds, & Gatz, 2001; Flint et al., 2010); however, anxiety in older adults is largely undetected, especially in medical settings (Calleo et al.,

2009; Kroenke, Spitzer, Williams, Monahan, & Lowe, 2007; Murphy, Sacks, Brady, Hootman, & Chapman, 2012). Older adults may also attribute their symptoms to other factors, such as physical illness or depression (Segal et al., 2011).

Anxiety is also associated with decreased cognitive functioning in older adults (for review, see Beaudreau & O'Hara, 2008). Notably, the relationship between cognition and anxiety in later life appears to be bi-directional: Awareness of cognitive decline may increase anxiety (Seignourel, Kunik, Snow, Wilson, & Stanley, 2008), but anxiety has also been associated with increased risk of later cognitive decline (e.g., Gallacher et al., 2009; Sinoff & Werner, 2003). Though some forms of cognitive impairment are potentially irreversible, anxiety, in contrast, is a treatable condition (i.e., Gonçalves & Byrne, 2011; Gould, Coulson, & Howard, 2012). Thus, treatment of anxiety in late life may result in preventing or delaying the onset of cognitive impairment in late life, at least in some cases. However, there is evidence to suggest the necessity of executive functioning skills in non-pharmacological treatment for anxiety, such as cognitive behavior therapy (i.e., Mohlman, 2005), likely rendering treatment more difficult in individuals with co-occurring cognitive impairment and anxiety.

This study focused on two major domains of cognition, memory and executive functioning. “Memory,” for the purposes of this study, reflects the ability to learn new information and to recall it after a delay of time (e.g., 10–20 min). “Executive functioning” encompasses several cognitive skills and has multiple definitions in the literature. This study focused on set-switching, abstraction

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or categorization ability, and initiation, which are among the core components of executive functioning or frontal lobe functioning assessed in the evaluation of older adults (Albert et al., 2011; Blumenfeld, 2010; Salmon & Bondi, 2009). These components are reliably measured, related to important outcomes (e.g., physical impairment and mortality; Vazzana et al., 2010), and are not excessively burdensome to assess with older adults who may fatigue more easily than younger adults. Notably, impairments in memory and executive functioning are included as diagnostic criteria for several dementing disorders such as Alzheimer's disease and vascular dementia (*DSM-IV-TR*, American Psychiatric Association, 2000; McKhann et al., 2011). Research suggests that these components of cognition are highly related. McCabe, Roediger, McDaniel, Balota, and Hambrick (2010) examined the relationship between working memory, executive functioning, and episodic memory in a sample of 206 adults ranging from 18 to 90 years of age. They found that the relationship between age and memory decline was eliminated after controlling for working memory and executive functioning (which they also referred to as executive attention). These findings suggest that late-life memory decline may be exacerbated or mediated by impairment in executive functioning abilities, such that executive impairment can account for episodic memory impairment in later life.

Research has also suggested that anxiety in late life has unique relationships with memory and executive functioning, and even mild anxiety symptoms are associated with lower cognitive functioning in healthy, community-dwelling older adults. However, these relationships appear to be complex, and results from studies have been contradictory in nature. Bierman, Comijs, Jonker, and Beekman (2005) reported that anxiety symptoms were predictive of worse performance on a delayed recall task of a verbal memory test, as well as decreased learning ability in a large sample of community-dwelling Dutch older adults. These researchers also noted that mild anxiety was associated with better cognitive performance, whereas severe anxiety symptoms negatively impacted cognition. Executive functioning was not assessed in this study. Pietrzak et al. (2011) found that mild worry symptoms at baseline predicted decreased performance on learning and memory tasks at a 2-year follow-up. Lower scores were observed in delayed recall on a verbal memory task in older individuals with mild worry at baseline, but this relationship was not evident in immediate recall. Older individuals with mild worry at baseline were also more likely to demonstrate clinically significant impairment in these cognitive domains at follow-up. As in Bierman et al.'s (2005) study, executive functioning was not assessed. Another limitation was that only cognitive symptoms of anxiety were assessed, and thus the impact of other symptoms of anxiety (i.e., somatic, affective) on cognitive functioning was unknown. Beaudreau and O'Hara (2009) found that anxiety symptoms were associated with decreased performance in several components of cognition, including processing speed, attention shifting, and inhibition. They also found that anxiety was not associated with verbal fluency and that anxiety was not significantly predictive of episodic memory scores (delayed recall). Beaudreau and O'Hara (2009) were the first to report the association between anxiety and lower performance in these specific cognitive abilities in individuals with sub-syndromal anxiety, and they used comprehensive neuropsychological tests to assess cognition. They did not examine other components of executive functioning, such as abstraction. In contrast to the findings that anxiety is associated with lower cognitive performance, Price and Mohlman (2007) found that clinically significant anxiety symptoms, as measured by the Penn State Worry Questionnaire, were associated with better executive functioning in the domain of inhibitory control, but only in patients with Generalized Anxiety Disorder. These contradictory findings may be related to differences in samples and measures of anxiety used. Beaudreau and

O'Hara (2009) utilized a community sample; Price and Mohlman's (2007) study involved a sample with Generalized Anxiety Disorder and matched controls. Beaudreau and O'Hara (2009) hypothesized that perhaps the relationship between inhibition and anxiety is curvilinear, whereby those with clinical symptoms of anxiety have greater inhibition and those with mild levels of anxiety show worse inhibition. Taken together, these findings indicate that a relationship likely exists between anxiety and memory even in higher-functioning individuals who do not experience clinically significant cognitive impairment and/or anxiety. To our knowledge, executive functioning and anxiety have not been examined in detail, aside from Beaudreau and O'Hara (2009) and Price and Mohlman (2007), and no study has considered executive functioning to be a potential mediator of the relationship between anxiety and memory functions in community-dwelling older adults.

Despite these important recent advances, there are several limitations to the existing research on anxiety and cognitive functioning in older adults. First, research in this area has generally lacked comprehensive assessment of memory and executive functioning and instead has relied upon brief measures of cognitive functioning, such as the Mini-Mental State Exam (e.g., DeLuca et al., 2005; Potvin, Forget, Grenier, Preville, & Hudon, 2011). Use of such brief measures may limit findings as they may not be sensitive to subtle cognitive impairment (Li, Ng, Kua, & Ko, 2006; O'Sullivan, Morris, & Markus, 2005; Trenkle, Shankle, & Azen, 2007) and they do not adequately assess executive functioning. Second, research in this area has largely been conducted with clinical samples (i.e., Airaksinen, Larsson, & Forsell, 2005; Mantella et al., 2007; Smitherman, Huerkamp, Miller, Houle, & O'Jile, 2007), including only individuals who meet the full diagnostic criteria for anxiety disorders or have comorbid anxiety and depressive disorders (DeLuca et al., 2005). Less attention has been dedicated to sub-syndromal anxiety and cognitive functioning. This is problematic as a significant number of older adults experience anxiety but do not meet the full diagnostic criteria for the disorder, and are thus excluded from research.

There is also an extensive literature supporting an association between depressive symptoms and cognitive decline in older adults. Depressive symptoms among older adults have been found to be related to decreased episodic memory (Boone et al., 1995; Rapp et al., 2005) and greater declines in memory over six years of time (González, Bowen, & Fisher, 2008). Likewise, symptoms of depression have been found to relate to decreased executive functioning in older adults (Lockwood, Alexopoulos, & van Gorp, 2002) including difficulty inhibiting, which may lead to ruminative thinking (von Hippel, Vasey, Gonda, & Stern, 2008), as well as other executive deficits (Elderkin-Thompson, Mintz, Haroon, Lavretsky, & Kumar, 2006). Depressive symptoms predict future executive functioning (Cui, Lyness, Tu, King, & Caine, 2007; Yochim, MacNeill, & Lichtenberg, 2006). An association between a history of depressive symptoms and the development of dementia has been found across studies using both retrospective and prospective data collection and strict diagnostic criteria for both dementia and symptoms of depression (Ownby, Crocco, Acevedo, John, & Loewenstein, 2006). In an ethnically diverse community population of over 4000 older adults, depressive symptoms were predictive of cognitive decline over a five-year period (Wilson, Mendes de Leon, Bennett, Bienias, & Evans, 2004), using measures of episodic memory, perceptual speed, and the MMSE, but no measures of executive functioning. Rapp et al. (2011) examined the relationship between major depressive disorder and cognitive decline in a sample of nursing home residents, and they found that the presence of major depressive disorder accelerated the rate of cognitive decline, particularly in individuals with a diagnosis of AD, beyond the effects of age, gender or education level. Taken together, these studies suggest that symptoms of depression appear to increase the risk of cognitive

decline, suggesting the importance of investigating both depressive and anxiety symptoms in regards to late life memory and executive functioning. Few studies have explored symptoms of both depression and anxiety and their relationship with cognitive functioning, particularly executive functioning and memory.

The purpose of the present study was to assess the degree to which symptoms of anxiety and depression are associated with verbal memory and several components of executive functioning (set-switching, abstraction, and initiation) among community-dwelling older adults. Based upon prior research (i.e., [Beaudreau and O'Hara, 2009](#); [Bierman et al., 2005](#); [Mantella et al., 2007](#)), we predicted that GAS total scores would predict decreased memory (specifically, immediate recall of verbal information) and decreased performance in the executive abilities of set-switching and abstraction, but not initiation (Hypothesis 1). More specifically, we hypothesized GAS Cognitive and Affective subscale scores would have the strongest relationships with these components of memory and executive functioning (Hypothesis 2). If cognitive functioning is related to anxiety, it is likely that it is related more to the psychological and emotional experience of anxiety than to physical symptoms. Indeed, studies (e.g., [Pietrzak et al., 2011](#)) that have found relationships between anxiety and cognition have assessed cognitive symptoms such as worry. [Beaudreau and O'Hara \(2009\)](#), who did not find a relationship between anxiety and memory, measured anxiety with the Beck Anxiety Inventory (BAI), which assesses primarily physical symptoms of anxiety. Depressive symptoms, on the other hand, were hypothesized to predict decreased memory, set-switching, and initiation, but not abstraction (Hypothesis 3). Lastly, we hypothesized that the relationship between anxiety symptoms and immediate recall, and depressive symptoms and immediate recall, would be explained by decreased categorization ability (Hypothesis 4). The current study expands on previous research by assessing domains of executive functioning not previously examined (i.e., abstract reasoning), utilizing a multidimensional, clinical measure of anxiety specifically intended for use with older individuals, and assessing whether executive functioning accounts for the relationship between anxiety symptoms and memory.

## 1. Method

### 1.1. Participants

A total of 120 community dwelling older adults (60 years old and older) participated in this study. They were recruited through a registry of older adults who have expressed interest in participating in research. They were contacted via phone call and invited to participate. Participants were eligible to participate if they were 60 years old or older and could arrange their own transportation to the testing center. Demographics of the sample are provided in [Table 1](#).

### 1.2. Measures

#### 1.2.1. Anxiety

*Geriatric Anxiety Scale (GAS)*. The GAS ([Segal, June, Payne, Coolidge, & Yochim, 2010](#)) is a self-report measure of anxiety symptoms designed for use with diverse older adult populations. Participants rate symptoms of anxiety or stress by indicating how often they have experienced each symptom during the past week on a Likert-type scale that ranges from 0 (*not at all*) to 3 (*all of the time*). There are 25 items assessing symptoms of anxiety and 5 items which assess specific content areas of worry relevant for older adults (i.e., finances, poor health, children, dying, and becoming a burden to others). Possible scores range from 0 to 75, with higher scores indicating the presence of more frequent and severe

anxiety. The GAS contains three subscales which allow the clinician or researcher to determine the specific type of symptoms that pose particular challenges for the respondent: Somatic (“My heart raced or beat strongly,” “I had difficulty staying asleep”), Affective (“I was afraid of being judged by others,” “I felt restless, keyed up, or on edge”) and Cognitive (“I felt like I was losing control,” “I worried too much”). The GAS may be preferable to other measures of anxiety as it was designed for use with older adults, contains items assessing three major aspects of anxiety, and was designed utilizing the diagnostic criteria for anxiety disorders. It also has sound psychometric properties in older populations. The GAS has been found to correlate with the Beck Anxiety Inventory (BAI;  $r = .61$ ) and Geriatric Anxiety Inventory ( $r = .69$ ; [Yochim, Mueller, June, & Segal, 2011](#)), indicating its validity for use as a measure of anxiety. [Yochim et al. \(2011\)](#) also reported that individuals who scored above the clinical cutoff on the BAI had a mean GAS score of 18.04 ( $SD 7.30$ ), suggesting that scores elevated at or beyond this cutoff reflect clinically significant anxiety. In the present sample, Cronbach's alpha for the overall scale score was 0.91, indicating high reliability. Cronbach's alpha was 0.74, 0.74, and 0.83 for the Somatic, Cognitive, and Affective subscale scores, respectively.

### 1.3. Depression

*Geriatric Depression Scale (GDS)*. The GDS ([Yesavage et al., 1983](#)) is a 30-item self-report measure of depressive symptoms designed for use with older adults. Participants are asked to circle *yes* or *no* to each question (e.g., “Are you basically satisfied with your life?”). Possible scores on the GDS range from 0 to 30, with higher scores indicating the presence of more depressive symptoms. Scores 11 and above indicate the presence of depression. The GDS has a wealth of psychometric support for diverse samples of older adults ([Marty, Pepin, June, & Segal, 2011](#)). Internal consistency of the GDS in the present study was not assessed because only the total score was entered into the database.

### 1.4. Health status

*Comorbidity Index (CMI)*. The CMI is a weighted measure of chronic diseases. This measure was developed by assessing the combination of medical diagnoses that best predicted one-year mortality in a group of hospitalized patients ([Charlson, Pompei, Ales, & MacKenzie, 1987](#)). Diseases significantly associated with mortality were identified and weights equivalent to adjusted relative risks were assigned. The Index was validated on a cohort of 685 medical patients by predicting 1-year survival and accounted for a greater proportion of the deaths due to co-morbid conditions than a simple measure of number of coexisting conditions alone. Weights given to diseases consist of a weight of 1 for conditions such as congestive heart failure or diabetes, 2 for conditions such as moderate or severe kidney disease or lymphoma, 3 for moderate or severe liver disease, or 6 for metastatic solid tumor. Scores on the CMI typically range from 1 to 3, but can range up to 9 or higher. The Comorbidity Index is a significant predictor of disability and mortality among older adults ([di Bari et al., 2006](#)).

### 1.5. Memory

*California Verbal Learning Test, second edition (CVLT-II)*; [Delis, Kramer, Kaplan, & Ober, 2000](#)). The CVLT-II is one of the most commonly used measures of verbal learning and memory ([Rabin, Barr, & Burton, 2005](#)). Examinees are read a 16-word list five times, and after each trial are asked to freely recall as many of the words as possible. The words on the list are from four semantic categories (animals, vegetables, modes of transportation, and furniture), which facilitates the learning of the list. One's ability to place

**Table 1**  
Demographics of sample and mean scores on Geriatric Anxiety Scale (GAS), Geriatric Depression Scale (GDS), CVLT-II, and D-KEFS measures.

Variable	Mean (SD); percentile	Range	Percent
Age	74.9 (7.2)	60–89	
Years of Education	15.0 (2.9)	8–24	
Sex			62% Women, 38% Men
Ethnicity			94% European American, 6% Hispanic American
Comorbidity Index	1.3 (1.7)	0–12	
Geriatric Anxiety Scale	12.6 (8.6)	0–42	
Geriatric Depression Scale	5.7 (6.0)	0–29	
CVLT-II Trials 1–5 T score	52.0 (11.5)	16–87	
CVLT-II Semantic Clustering z score	0.3 (1.4)	–2.0–5.0	
CVLT-II Long Delay Free Recall z score	0.0 (1.1)	–2.5–3.0	
D-KEFS Trail Making, Number–Letter Switching condition, scaled score	10.9 (3.4)	2–16	
D-KEFS Letter Fluency, scaled score	10.5 (3.2)	3–19	
D-KEFS Category Fluency, scaled score	11.5 (3.4)	4–19	
D-KEFS 20 Questions, Initial Abstraction, scaled score	10.0 (3.2)	3–19	

Note. N = 122; CVLT-II = California Verbal Learning Test, Second Edition; D-KEFS = Delis–Kaplan Executive Function System.

the words into categories is assessed by the Semantic Clustering score on the CVLT-II. The Semantic Clustering score is thought to assess how well an examinee uses categorization strategies to facilitate learning. This study utilized the total number of words recalled in Trials 1–5 and the total number of words recalled after a 20-min delay as measures of verbal memory, and the Semantic Clustering score as a measure of the ability to use categorization skills to facilitate learning. The CVLT-II has high reliability and demonstrated validity for use as a measure of verbal memory (Delis et al., 2000). The standardized scoring of CVLT-II variables norms raw scores on age and gender, and these standardized scores were used for data analyses.

### 1.6. Executive functioning

The following subtests of the Delis–Kaplan Executive Function System (D-KEFS) were administered. The creators of this battery (Delis, Kaplan, & Kramer, 2001) apply an age correction to the raw scores; however, no correction for education is provided in the normative data provided with this measure. Fine, Delis, and Holdnack (2011) found that education was a significant predictor of D-KEFS Trail Making test scores. In the sample for the current study, education correlated not only with D-KEFS Trail Making Scores,  $r = -.35$ ,  $p < .001$ , but also D-KEFS Category Fluency scores,  $r = -.34$ ,  $p < .001$ . Education did not correlate with D-KEFS Letter Fluency,  $r = .14$ ,  $p = .12$  or 20 Questions Initial Abstraction scores,  $r = .14$ ,  $p = .13$ . Additionally, women and men did not differ on any D-KEFS measures.

**Trail Making subtest.** The D-KEFS Trail Making subtest (Delis et al., 2001) contains five conditions. The second, third, and fourth conditions were a focus in this study. On the second condition, Number Sequencing, the examinee connects numbered dots in numerical order. On the third condition, Letter Sequencing, the examinee connects dots with letters in them in alphabetical order. These two conditions tap into processing speed and numerical and alphabetical sequencing. On the fourth condition, Number–Letter Switching, the participant draws a line connecting dots, alternating between dots containing numbers and dots containing letters. This is a commonly used measure of set-switching, or cognitive flexibility. This measure has high reliability (Delis et al., 2001) and has been used extensively as a measure of executive functioning in community-dwelling older adults (e.g., Oosterman et al., 2010; Vazzana et al., 2010). For this study, the total completion time was used as a measure of set-switching, with lower scores indicating better performance.

**Verbal Fluency subtest.** The D-KEFS Verbal Fluency subtest (Delis et al., 2001) has two conditions: a Letter Fluency subtest and a

Category Fluency subtest. On the Letter Fluency test, participants are asked to generate as many words as possible that begin with a given letter within 1 min. This is completed for three letters (F, A, and S) for one minute each. On the Category Fluency subtest, participants are asked to generate as many words as possible from a semantic category. This is completed for two categories (animals or boys names) for 1 min each. The Verbal Fluency tests are a commonly used measure of executive functioning and/or language.

**20 Questions subtest.** The D-KEFS 20 Questions subtest (Delis et al., 2001) is a measure of abstraction, which is one component of executive functioning. Participants are shown a sheet that has 30 items on it and are supposed to ask the fewest number of yes/no questions to identify a predetermined item. The 30 items can be placed into categories (e.g., animals, kitchen items), which presumably involves abstraction skills; placing the items into categories enables the participant to guess the item with fewer questions. Examinees are asked to identify a total of four items. The first question an examinee asks (e.g., “is it an animal?”) often eliminates a number of items, and the number of items eliminated is the Initial Abstraction score. The Initial Abstraction Score is the most reliable score obtained from this measure (Delis et al., 2001) and is thought to reflect how well the examinee is able to engage in abstract thought or place things into categories. As a demonstration of validity, scores on this measure were significantly lower among patients with frontal lobe lesions than in age- and education-matched controls (Baldo, Delis, Wilkins, & Shimamura, 2004).

### 1.7. Procedure

The CVLT-II and D-KEFS were administered according to standardized instructions in their test manuals. The CVLT-II was administered first, followed by the D-KEFS measures, followed by self-report measures. Participants self-completed written forms of the Comorbidity Index, GAS, and GDS. All reported having vision intact enough to read the forms. Data were gathered by research assistants completing a MA or PhD degree in clinical psychology who received comprehensive training and supervision by a board-certified clinical neuropsychologist. Participants were tested individually in a quiet room on a university campus or in an off-campus gerontology research center and were subsequently debriefed. The study was approved by the institutional review board of the University.

### 1.8. Statistical analyses

All analyses were conducted with standard scores on the measures that were normed according to the CVLT-II and D-KEFS scoring

software. Multiple regressions were conducted to determine the degree to which anxiety and depression were related to performance on these measures after controlling for participant health status. Thus, in all regressions, CMI scores were entered in Block 1, and GAS scores or GDS scores were added in Block 2. For analyses predicting D-KEFS Trail Making and D-KEFS Category Fluency scores, education (measured in years) was also included as a predictor. For the prediction of CVLT-II scores, an analysis was also conducted in which the CVLT-II Semantic Clustering score was entered as an additional predictor to assess if it explained the relationship between GAS and CVLT-II Trials 1-5 total, or GDS and CVLT-II Trials 1-5 total.

**2. Results**

Mean scores on the GAS, GDS, and CMI, and mean standard scores on the CVLT-II and D-KEFS measures are presented in Table 1. The mean GAS total score of 12.6 in this sample is similar to the average score in the normative sample (Segal et al., 2010) of community-dwelling older adults and represents relatively mild levels of anxiety with significant variation (range = 0–42). GAS and GDS total scores were uncorrelated with age or education. Pearson correlations between the primary measures of this study are displayed in Table 2.

Next, a series of multiple regression analyses were performed in order to assess how well GAS and GDS scores predicted CVLT-II and D-KEFS performance after controlling for health status. These results are presented in Table 3. As can be seen in Table 3, GAS scores were associated with decreased immediate verbal memory (CVLT-II, Trials 1-5),  $\beta = -.19, p < .05$ . Although GAS Total, Somatic, and Cognitive scores were uncorrelated with CVLT-II Semantic Clustering scores, GAS Affective scores predicted CVLT-II Semantic Clustering scores,  $\beta = -.20, p < .05$ . GAS Affective scores also predicted CVLT-II Trials 1-5,  $\beta = -.25, p < .01$ . In order to determine whether decreased categorization ability explained the relationship between higher GAS Affective scores and lower immediate memory, a regression was conducted in which GAS Affective scores and Semantic Clustering scores were both entered as predictors of CVLT-II Trials 1-5. GAS Affective scores became nonsignificant,  $\beta = -.15, p > .05$ , and Semantic Clustering scores were significant,  $\beta = .48, p < .001$ . This suggests that the relationship between GAS Affective scores and immediate memory can be explained by decreased Semantic Clustering.

Higher GAS scores also predicted decreased D-KEFS Trail Making Number–Letter Switching,  $\beta = -.26, p < .01$ , and remained significant after controlling for D-KEFS Trail Making Number Sequencing and Letter Sequencing,  $\beta = -.22, p < .01$ . Anxiety symptoms were not related to performance on Number Sequencing,  $\beta = -.02, p = .86$ , or Letter Sequencing,  $\beta = -.11, p = .28$ , alone, suggesting that the relationship between anxiety symptoms and set-switching was not explained by deficient processing speed. GAS scores also predicted D-KEFS 20 Questions Initial Abstraction scores,  $\beta = -.24, p < .05$ . The only GAS score correlated with D-KEFS Letter Fluency or Category Fluency was GAS Somatic subscale scores, which were correlated with D-KEFS Letter Fluency. However, after controlling for health status, GAS Somatic scores were unrelated to D-KEFS Letter Fluency,  $\beta = -.15, p > .05$ . Thus, anxiety symptoms were not related to verbal fluency performance.

Regressions were also conducted with depressive symptoms as a predictor. GDS scores significantly predicted CVLT-II Trials 1-5,  $\beta = -.22, p < .05$ . GDS scores were unrelated to CVLT-II Semantic Clustering,  $\beta = -.18, p > .05$  after controlling for health status; thus, decreased semantic clustering did not explain the relationship between GDS scores and CVLT-II Trials 1-5. GDS scores predicted D-KEFS Trail Making Number–Letter Switching,  $\beta = -.26, p < .01$ ,

**Table 2**  
Correlations among demographic variables, Geriatric Anxiety Scale scores, Geriatric Depression Scale scores, and CVLT-II and D-KEFS measures.

	GAS total	GAS somatic	GAS cognitive	GAS affective	GDS	CVLT-II Trials 1-5	CVLT-II semantic clustering	CVLT-II long delay free recall	Trail making	20 Q initial abstraction	Letter fluency
GAS Somatic	.91**										
GAS Cognitive	.90**	.75**									
GAS Affective	.92**	.75**	.74**								
Geriatric Depression Scale	.78**	.68**	.68**	.76**							
CVLT-II Trials 1-5	-.22	-.17	-.16	-.27**	-.24**						
CVLT-II Semantic Clustering	-.17	-.15	-.09	-.22	-.20	.52**					
CVLT-II Long Delay Free Recall	-.14	-.11	-.10	-.17	-.15	.77**	.51**				
Trail Making	-.24**	-.21	-.19	-.26**	-.26**	.41**	.29**	.39**			
20 Q Initial Abstraction	-.22	-.20	-.16	-.24**	-.18	.23	.31**	.38**	.38**		
Letter Fluency	-.16	-.21	-.09	-.15	-.23	.34**	.32**	.29**	.29**	.19*	
Category Fluency	-.13	-.09	-.11	-.16	-.24**	.37**	.36**	.42**	.42**	.17	.53**

Note. N = 122; CVLT-II = California Verbal Learning Test, Second Edition; D-KEFS = Delis–Kaplan Executive Function System; 20 Q = Twenty Questions.

\*  $p < .05$ .  
\*\*  $p < .01$ .

**Table 3**  
Multiple regression results.

Predictor	B	SE B	$\beta$	R <sup>2</sup>
DV: CVLT-II Trials 1-5				
CMI	-.63	.63	-.10	
GAS	-.26	.13	-.19*	.06
CMI	-.84	.61	-.13	
GDS	-.44	.18	-.22*	.08
DV: D-KEFS Trail Making, Number-Letter Switching				
CMI	-.03	.18	-.02	
Years of Education	.31	.10	.28**	
GAS	-.08	.04	-.21*	.14
CMI	-.10	.18	-.05	
Years of Education	.36	.10	.31**	
GDS	-.13	.05	-.23*	.16
DV: D-KEFS Letter Fluency				
CMI	-.22	.18	-.12	
GAS	-.04	.04	-.10	.03
CMI	-.21	.17	-.11	
GDS	-.11	.05	-.20*	.06
DV: D-KEFS Category Fluency				
CMI	-.03	.19	-.01	
Years of Education	.34	.11	.30**	
GAS	-.03	.04	-.06	.10
CMI	.01	.17	.00	
Years of Education	.34	.10	.29**	
GDS	-.12	.05	-.20*	.14
DV: D-KEFS 20 Questions, Initial Abstraction				
CMI	.05	.18	.03	
GAS	-.09	.04	-.24*	.05
CMI	-.06	.17	-.03	
GDS	-.09	.05	-.17	.03

\*  $p < .05$ .

\*\*  $p < .01$ .

even after controlling for D-KEFS Trail Making Number Sequencing and Letter Sequencing,  $\beta = -.18$ ,  $p < .05$ . GDS scores also were unrelated to Number Sequencing,  $\beta = -.08$ ,  $p = .39$ , or Letter Sequencing,  $\beta = -.18$ ,  $p = .06$ , suggesting that the relationship between depressive symptoms and set-switching was not explained by deficient processing speed. GDS scores also predicted D-KEFS Letter Fluency,  $\beta = -.20$ ,  $p < .05$ , and Category Fluency,  $\beta = -.25$ ,  $p < .01$ .

### 3. Discussion

This study examined the relationships among anxiety and depression symptoms, memory, and executive functioning in a large sample of community-dwelling older adults. We found that anxiety symptoms, particularly affective symptoms of anxiety, were related to decreased performance on an immediate verbal memory recall test, and that this relationship was explained by semantic clustering ability. Additionally, anxiety symptoms were related to lowered performance on several tests of executive functioning, including categorization and set-switching. These results support a model in which the association between anxiety symptoms and memory can be explained by poor categorization ability. That is, symptoms of anxiety may decrease one's ability to place new information into categories in order to facilitate learning. This has clinical implications in that older adults presenting with anxiety symptoms and decreased memory functioning may benefit from intervention in this component of learning new information. This study sheds new light on the unique associations late-life anxiety and depression have with memory and executive functioning.

Anxiety in this sample was related to the ability to learn new information on a verbal memory task (immediate verbal memory). This is similar to Bierman et al. (2005) and Mantella et al. (2007), who also found that anxiety symptoms were predictive of decreased learning on a verbal learning task. We found that this relationship was explained by decreased performance on the Semantic Clustering component of the CVLT-II; that is, affective anxiety symptoms were related to worsened ability to place new information into categories to facilitate learning. The notion of anxiety symptomatology interfering with categorization ability was also supported by the relationship between GAS scores and D-KEFS 20 Questions performance in this sample. These findings suggest that anxiety may not be related with poor memory per se, but poor ability to utilize executive skills in the learning of new information. For example, executive skills can be used to place information into categories to add structure to incoming information, which may increase retention and recall after a delay. Reduced executive functioning may be related to anxiety posing a high cognitive load, preventing one from having all cognitive resources available for executive tasks such as abstraction. Alternatively, it could be that individuals with lower executive functioning abilities are less able to suppress anxiety. Depressive symptoms also predicted immediate verbal memory, consistent with Wilson et al.'s (2004) findings, but contrarily, was not related to performance on an abstraction task. This suggests that anxiety has a unique relationship with this component of executive functioning which impacts the ability to learn new information.

This model of executive functioning explaining the relationship between anxiety and memory is similar to McCabe and colleagues (2010), and may explain the relationship between anxiety and poor memory among community-dwelling older adults. One clinical implication of these results is that if an older adult shows poor learning of information (i.e., fewer words learned on Trials 1-5 of the CVLT-II) but a lack of forgetting, it may be due to anxiety symptoms rather than a dementing disorder such as Alzheimer's disease. Alzheimer's disease is characterized more by rapid forgetting (McKhann et al., 2011; Salmon & Bondi, 2009). Interventions with individuals with predominant anxiety symptoms could target categorization and learning abilities to facilitate retention of memory skills. Additionally, information may need to be presented multiple times to an older adult with sub-syndromal anxiety to ensure recall at a later time.

Findings suggest that affective symptoms of anxiety (e.g., feeling irritable, fear of embarrassment, feeling restless) are related to more components of memory and executive functioning than somatic or cognitive symptoms. Interestingly, cognitive anxiety symptoms (e.g., worrying) were correlated with set-switching ability but no other cognitive domains. This suggests that symptoms of worry may take up less cognitive load and interfere with memory and executive functioning less than affective symptoms like irritability or restlessness.

Neither anxiety nor depressive symptoms were significantly related to free recall of information after a time delay. This suggests that sub-syndromal anxiety and depression in older adults may each interfere with learning new information but less with retention of what they are able to learn. This is consistent with Beaudreau and O'Hara (2009), who also did not find a significant relationship between episodic memory (as assessed with delayed recall) and anxiety symptoms. In contrast, Pietrzak et al. (2011) reported that mild worry symptoms at baseline, as measured by the Penn State Worry Questionnaire, predicted lower delayed recall performance, but not immediate recall, at a 2-year follow-up. This disparity could be explained by the measure of memory used in each study. Our study utilized the CVLT-II, which involves the presentation of 16 words in a fixed order, whereas Pietrzak et al.'s study utilized a different measure, the International Shopping List Test,

which involves the presentation of 12 words via a computer in a random order with each trial. Another difference between Pietrzak et al.'s (2011) study and ours and Beaudreau and O'Hara's (2009) is the longitudinal nature of Pietrzak et al.'s (2011) study. It is also possible that our sample lacked the statistical power needed to detect a small effect between delayed verbal memory and GAS scores.

Anxiety and depression symptoms were also related to performance on a cognitive set-switching task (D-KEFS Trail Making, Number-Letter Switching), even after controlling for performance on simpler component measures of processing speed (Number Sequencing and Letter Sequencing). Neither anxiety nor depression was related to processing speed, as measured by these simpler component measures. This contrasts with Beaudreau and O'Hara (2009), who found that anxiety predicted slower processing speed on the Symbol-Digit Modalities Test. This finding could be explained by the slightly more complex nature of the Symbol-Digit Modalities test as compared with the Number Sequencing and Letter Sequencing components of the D-KEFS Trail Making test.

Our findings also contrast with Smitherman et al. (2007), who found that a measure of anxiety was unrelated to the traditional Trail Making Test, parts A or B. This discrepancy could be explained by different measures of anxiety used in the two studies and by the focus on older adults in this study. The mean age of Smitherman et al.'s sample was 36 years, compared to our mean age of 75, and they utilized a mixed psychiatric sample. Overall, our findings suggest that older adults with sub-syndromal anxiety or depression may have difficulty in switching between two lines of thought or completing multiple tasks simultaneously. This could affect work productivity or the ability to engage in complex, multifaceted tasks like driving or participating in social functions.

Verbal fluency involves the executive skill of initiation, or the ability to start a novel cognitive task (Delis et al., 2001; Yochim, Lequerica, MacNeill, & Lichtenberg, 2008). Increased depressive symptoms were related to performance on a verbal fluency task, consistent with prior studies (e.g., Henry & Crawford, 2005; Yochim et al., 2006). Anxiety was not significantly related to verbal fluency, similar to findings from studies on anxiety with both clinical (Airaksinen et al., 2005; Smitherman et al., 2007) and community-dwelling samples (Beaudreau & O'Hara, 2009). This also suggests that anxiety is not related to all executive functions in the same manner).

The results from the present study have several implications for the treatment of symptoms of anxiety and depression in older adults. The relationship between decreased executive functioning and mental health problems is particularly concerning as deficient executive functioning may render cognitive behavioral treatment less effective in the treatment of anxiety in later life (for review, see Mohlman, 2005). Thus, cognitive training may be an essential component of the treatment of anxiety and/or depressive disorders in late life (Mohlman, 2008). Additionally, Butters et al. (2011) reported that pharmacological treatment for anxiety also resulted in improvement in episodic memory and executive functioning (specifically on measures of inhibition and categorization). Thus, successful treatment of anxiety symptoms may also improve memory and executive functioning in older adults. Exercise intervention programs have also demonstrated improvements in executive functioning in sedentary, healthy older individuals (Colcombe & Kramer, 2003). Furthermore, treatment for depressive symptoms in older adults may need to place some emphasis on increasing initiation in pleasant activities (e.g., using behavioral activation), as depressive symptoms are associated with decreased initiation abilities. Future research should further explore these potentially unique relationships between anxiety, depression, and the various subcomponents of executive abilities, and their implications for the treatment of co-occurring mental illness and cognitive impairment in older adults.

This study is not without limitations. First, the study utilized a sample of generally well-educated, European American older adults, the majority of whom were not experiencing clinically significant anxiety or depression. This limits the ability of the results to generalize to more diverse and/or more severely anxious or depressed samples. Second, this sample was cross-sectional in nature; thus, the causality among variables remains unknown. Third, we did not examine the executive skill of inhibition, which has been found to correlate with anxiety by previous researchers (Beaudreau & O'Hara, 2009; Price & Mohlman, 2007).

In summary, the current study adds to the growing literature on anxiety, depression, and cognition. This study is one of the first in-depth explorations of these relationships in community-dwelling older adults, and provides evidence that the relationship between memory and anxiety may be mediated by poor executive ability in this sample. Another strength is the use of a multidimensional measure of anxiety designed specifically for older individuals. Overall, this study indicates that anxiety, depression, and cognitive functioning share unique associations even individuals who may not be experiencing clinically significant anxiety and/or cognitive impairment. In the differential diagnosis of anxiety versus depression in older adults, those who show lowered abstraction ability might be experiencing anxiety, whereas those with decreased initiation might have symptoms of depression. Future research should continue to examine the complex relationships among anxiety, memory, and executive functions in late life.

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