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The Association of Anxiety and Depressive Symptoms with Cognitive Performance in Community-Dwelling Older Adults

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Abstract

We examined the association of anxiety, depressive symptoms, and their co-occurrence on cognitive processes in 102 community-dwelling older adults. Participants completed anxiety and depression questionnaires, and measures of episodic and semantic memory, word fluency, processing speed/shifting attention, and inhibition. Participants with only increased anxiety had poorer processing speed/shifting attention, and inhibition, but depressive symptoms alone were not associated with any cognitive deficits. Although co-existing anxiety and depressive symptoms was associated with deficits in 3 cognitive domains, reductions in inhibition were solely attributed to anxiety. Findings suggest an excess cognitive load on inhibitory ability in normal older adults reporting mild anxiety.

Keywords

anxiety; depression; cognition; older adults

Compelling empirical evidence suggests that anxiety and cognition are uniquely related in older adults (Beaudreau & O'Hara, 2008). Cognitively impaired older adults exhibit a greater prevalence of anxiety symptoms compared with cognitively intact older individuals (Hwang, Masterman, Ortiz, Fairbanks, & Cummings, 2004; Lyketsos et al., 2002; Tatsch et al., 2006). Older adults reporting elevated state anxiety, trait anxiety, or anxiety symptoms also demonstrate poorer global cognitive function on screening assessments (Schultz, Moser, Bishop, & Ellingrod, 2005; Sinoff & Werner, 2003) and on challenging neuropsychological tests (Booth, Schinka, Brown, Mortimer, & Borenstein, 2006; Hogan, 2003; Wetherell, Reynolds, Gatz, & Pedersen, 2002). Mantella et al. (2007) found that older patients with generalized anxiety disorder exhibited deficits in shifting attention and episodic memory not observed in patients with major depression. Co-occurring anxiety disorders in late-life depression also appear to confer a risk for accelerated memory decline over time (DeLuca et al., 2005). To date, few investigations have delineated the potential relationship of commonly experienced, milder anxiety and depressive symptoms with cognitive performance in community dwelling older adults.

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Prior studies of this issue in clinical populations and the few conducted in normal populations have constraints. First, many rely on cognitive batteries insensitive to very mild impairments. This reduces the ability to capture lower than expected or potentially impaired cognitive performance on measures for which community dwelling older adults are apt to demonstrate a ceiling effect. Second, some studies categorize older participants by the presence of a cognitive disorder rather than performance on specific cognitive tests. This limits the ability to dissociate the areas of cognitive function detrimentally related to either anxiety or depression.

Furthermore, studies of normal older adults typically employ trait or personality measures rather than clinical measures of anxiety symptoms, limiting understanding of milder psychiatric anxiety symptoms on cognitive function. Finally, although anxiety and depressive symptoms frequently co-occur, their combined effect on cognitive functioning is rarely considered. This is particularly important because anxiety and depression are more highly correlated in older compared with younger adults (Wetherell, Gatz, & Pedersen, 2001) and their occurrence increases from middle to older adulthood (Teachman, 2006). Thus, a primary aim of this investigation was to discern if distinct cognitive deficits are associated with anxiety and not better accounted for by depression or co-occurring anxiety and depressive symptoms.

Contemporary views of cognitive aging increasingly recognize the importance of noncognitive variables, such as affective processing, for continued development of theoretical models to understand age-associated decrements in cognition (McDaniel, Einstein, & Jacoby, 2008). A common feature of theories about cognitive processing of anxiety is a preoccupation with threat information (Coles & Heimberg, 2002; Eysenck & Calvo, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007). Anxiety is posited to divert attention to internal (i.e., worry) or external threat, thereby reducing available attentional resources to perform a task (Eysenck et al., 2007). This interferes with attentional control on tasks involving inhibition of a prepotent response, shifting between tasks, and the ability to monitor and update information in working memory (Eysenck et al., 2007). Preoccupation with threat information coupled with age-associated reductions in cognitive processing could potentially lead to reductions in attention and other executive functions, such as inhibition, in mildly anxious, normal older adults.

A key distinction proposed between affective processing in anxiety and depression is the amount of exposure to negative information needed to produce the bias. Whereas this occurs with minimal exposure to threat stimuli in anxiety, longer exposure may be required for elaborative processing of negative information in depression (Donaldson, Lam, & Mathews, 2007). This tendency toward elaborative processing in depression could thwart sustained effort on demanding motor tasks (Cohen, Weingartner, Smallberg, Pickar, & Murphy, 1982), and on cognitive tasks, such as episodic memory (Cohen, et al., 1982) or those integrating multiple abilities (i.e., attention, memory, abstract reasoning) (Silberman, Weingartner, & Post, 1983).

Comorbid anxiety potentially underlies executive function deficits observed in depression. Executive function deficits and global cognitive impairment are associated with clinically diagnosed depression with anxiety in younger adults (Basso et al., 2007). After adjusting for age, clinical depression without anxiety is not associated with executive dysfunction in older or younger adults (Thomas et al., 2008). Episodic memory deficits, however, may be unique to depression as they are associated with depressive disorder alone in younger adults (Basso et al., 2007). Even after adjusting for age differences, late-life major depression is also associated with greater impairment in episodic memory compared with depression in the young to middle adult years (Thomas et al., 2008). Further, in non-depressed older adults,

motivation related depressive symptoms are associated with episodic memory even when there is environmental support, such as cues or increased study time (Bäckman, Hill, & Forsell, 1996). While suggestive, the combined and independent impact of milder symptoms of anxiety and depression on cognitive functioning in normal aging is unknown.

Disentangling the unique detrimental association of anxiety and depressive symptoms on cognitive function in older adults is a critical first step for theory development and for specifying potential biological mechanisms underlying mental health correlates of cognitive impairment.

Hypotheses

The goal of the present study was to determine how milder anxiety and depressive symptoms, and their co-existence differentially map onto specific domains of cognitive function in older adults. Specifically, we examined the association between symptoms of anxiety, depression, and their co-occurrence in a large community sample of normal older adults on neuropsychological tests assessing 5 cognitive domains: (a) episodic memory, (b) inhibitory control, (c) processing speed and shifting attention, (d) word fluency, and (e) semantic memory. Three primary hypotheses were tested based on theoretical and empirical literature suggesting (a) increased anxiety symptoms are associated with decrements in executive function—inhibitory control, shifting attention, and ability to monitor and update information in working memory; (b) depression weakens performance on measures of learning and delayed episodic memory or on tasks that require effortful processing and speed, namely processing speed and shifting attention. The first 2 hypotheses focus on the detrimental association on cognitive performance of anxiety in the absence of depressive symptoms, and depressive symptoms in the absence of anxiety.

Hypothesis 1: Reductions across executive function abilities (i.e., inhibitory control, processing speed and shifting of attention, word fluency) are predicted in older adults reporting increased anxiety symptoms.

Hypothesis 2: Increased numbers of depressive symptoms will be associated with reduced episodic memory, and reduced processing speed/shifting attention.

Only 1 executive function measure was expected to be associated with both anxiety and depressive symptoms—processing speed/shifting attention. This overlap was expected because anxiety was hypothesized to be associated with all 3 domains of executive function, whereas depression was only hypothesized to be associated with effortful processing and processing speed, core features of the processing and shifting attention task. The other 2 executive function measures (inhibition and word fluency) were predicted to be uniquely associated with anxiety.

The third hypothesis concerned the detrimental association of co-existing anxiety and depressive symptoms on cognitive performance in older adults. Despite limited empirical information, we reasoned that the combined influence of anxiety on executive functions, and depressive symptoms on episodic memory and elaborative processing would underlie poorer performance on all cognitive domains.

Hypothesis 3: Reductions across all 5 measures of cognitive performance were predicted in the presence of both increased anxiety and depressive symptoms.

Method

Participants

Participants were 102 healthy, older adults with complete baseline data from an original sample of 120 enrolled in larger longitudinal investigation of physiological variables associated with cognition (Dr. Ruth O'Hara, PI). Participants were recruited from the community through flyers, local radio and internet advertisements, through contacts with local senior centers, or Stanford University. Seven older adults dropped out before baseline testing; the other 11 were excluded because they were under age 60. Participants were also excluded if they had an existing diagnosis of a serious medical problem, such as cancer, diagnosed sleep apnea, serious pulmonary disease, or met criteria for a psychiatric disorder during the past two years on a computerized version of the Structured Clinical Interview for DSM-IV: Computerized Edition (First et al., 1995); or scored <26 on the Mini Mental State Exam (Folstein, Folstein, & McHugh, 1975), indicative of possible dementia.

Procedure

After providing informed consent, enrolled older adults completed baseline testing during two 2 1/2 hour sessions at the laboratory or in their home with the aid of a trained bachelor's level research assistant. Participants first completed mood and anxiety questionnaires and during a second session completed neuropsychological tests. All enrollees received \$50 compensation for their participation in baseline testing.

Mood and Anxiety Measures

Depressive symptoms—The Geriatric Depression Scale—Long (Yesavage et al., 1983), a widely used self-report measure of depression validated in older adults, was used to assess for depressive symptoms. It has good convergent validity with depression measures and discriminates between older adults with depression, no depression, and dementia but no depression (O'Hara & Yesavage, 2002). This 30-item scale consists of five factors: sad mood, behavioral agitation, social withdrawal, hopelessness, and lack of vitality (Sheikh, et al., 1991). All items are presented in a yes or no format, including 10 that are reverse scored.

Anxiety symptoms—The Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988) is a brief self-report measure of bother by anxiety symptoms. It has support for its use with older community, medical, and psychiatric populations (Morin et al., 1999; Steer, Willman, Kay, & Beck, 1994; Wetherell & Areán, 1997). This inventory asks participants to indicate how much 21 different anxiety symptoms bothered them during the past week, from 0 (*not at all*) to 3 (*severely/I could barely stand it.*) The first 20 participants completed the BAI by phone within two weeks of their baseline testing; the remaining 86 completed it in person. The phone vs. in person format did not significantly influence reports of anxiety symptoms on the BAI, $t(55.65) = -.29, p > .05$, thus analyses included participants who completed it over the phone or in person.

Neuropsychological tests

Episodic memory—The Rey Auditory Verbal Learning Test (RAVLT; Rey, 1958; Lezak, 1983) measures learning and memory for 15 unrelated words presented at one-second intervals across 5 trials with each trial followed by free recall. Long delayed recall (20-min) measured episodic memory.

Inhibition—The Stroop Color and Word Test (STROOP; Golden, 1978) consists of 3 timed trials where the participant is asked to say aloud: (a) color words (red, green, blue) printed in standard black ink; (b) the color of ink in which XXXs are printed (red, green, and blue);

and (c) the color of ink for an incongruent ink and color word (e.g., to say “blue” for the word RED printed in blue ink). Ability to inhibit irrelevant information was based on time in seconds to complete the incongruent task; lower scores indicate better inhibitory ability. Adjusting for the color reading and the word reading conditions did not change the results.

Processing Speed/Shifting Attention—The Symbol Digit Modality Test (SDMT; Smith, 1982) is a test of rapid transcription of numbers to match symbols within a 90-second time limit. It measures processing speed and ability to shift attention.

Word Fluency—The Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1989; Spreen & Strauss, 1991) assesses word fluency by asking participants to name as many words as they can in 60 seconds beginning with the letters “F”, “A”, and “S”.

Semantic Memory—The Boston Naming Test—Second Version (BNT-II; Kaplan, Goodglass, & Weintraub, 1983) assesses spontaneous and cued naming ability for 60 line drawings depicting common objects.

Statistical Analysis

Five hierarchical multiple linear regressions were conducted—one for each cognitive test—RAVLT, STROOP, SDMT, COWAT, and BNT-II. The dependent variable was the raw cognitive test score. The independent variables were the main effects of BAI and GDS scores (step 1) and the interaction between BAI and GDS scores (step 2). All independent variables were centered based on deviations from the median as suggested by Kraemer and Blasey (2004).

Results

Sample characteristics

Older enrollees ranged from 60- to 89-years old (median age = 71.0, $SD = 7.4$). Participants were Caucasian (89.2%; $n = 91$), African American (1%; $n = 1$), Asian (5.9%; $n = 6$), and Latino (3.9%; $n = 4$). They were generally well educated (Years of education: $Mdn = 16$; $SD = 2.5$) and missed few if any items on the MMSE (MMSE score: $Mdn = 29/30$; $SD = 1.3$).

Descriptive Statistics for Mood, Anxiety, and Cognitive Measures

Table 1 provides descriptive statistics for all measures. Despite exclusionary criteria for psychiatric disorders, 83.3% ($n = 95$) of older adults indicated feeling bothered by at least 1 anxiety symptom. In addition, 25.5% ($n = 26$) reported clinically significant bother by anxiety symptoms classified as mild ($n = 13$), moderate ($n = 7$), or severe ($n = 1$). As expected, older adults reporting increased anxiety endorsed more depressive symptoms, $r = .47$, $p < .05$. Anxiety and depressive symptom scores were comparable to those obtained in large community samples upon which the BAI (Morin et al., 1999) and GDS (Yesavage et al. (1983) are normed.

Anxiety, Depression, and their Interaction in Relation to Specific Cognitive Domains

Table 2 summarizes the results of five multiple linear regression analyses examining five cognitive domains: inhibitory control (Stroop Color and Word test; STROOP), word fluency (Controlled Oral Word Association Test; COWAT), processing speed/shifting attention (Symbol Digit Modality test; SDMT), semantic memory (Boston Naming Test; BNT), and episodic memory (Rey Auditory Verbal Learning Test; RAVLT). To summarize, elevated anxiety related to poorer performance on two of the 3 executive function tasks: processing speed/shifting attention (SDMT), $R^2 = .11$, $p < .01$, and inhibition (STROOP), $R^2 = .12$, $p < .$

01. Increased number of depressive symptoms was correlated with poorer episodic memory (RAVLT) only, but this association was not significant $R^2 = .06, p = .059$. The interaction between anxiety and depression was associated with several cognitive domains: processing speed/shifting attention (SDMT), $R^2 \Delta = .03, p = .05$, episodic memory (RAVLT), $R^2 \Delta = .05, p < .05$, and semantic memory (BNT), $R^2 \Delta = .05, p < .05$. Poorer inhibitory performance (STROOP) was the only cognitive task associated with anxiety, but not the interaction between anxiety and depression.

Discussion

We predicted that anxiety symptoms alone would be associated with the following executive processes: inhibition, processing speed/shifting attention, and word fluency. Although anxiety symptoms were associated with poorer inhibition and slower processing speed/shifting attention, there was no significant relationship between increased anxiety and word fluency. This suggests that increased levels of anxiety symptoms in older adults are not associated with all executive function processes. Because processing speed/shifting attention was also associated with co-existing anxiety and depressive symptoms, only inhibitory ability was focally associated with anxiety. Inhibitory ability may be particularly vulnerable in mildly anxious, older adults who experience a “load” on their ability to inhibit information due to age and anxiety symptoms.

Although depressive symptoms in the absence of anxiety were not significantly associated with any of the cognitive domains, there was a small, nonsignificant effect for more depressive symptoms and poorer episodic memory as predicted by the theory of effortful processing. Our community sample consisted of broad range of depressive symptom self reports, but most reported a mild presence of depression symptoms. It is possible that a sample containing older adults endorsing more depressive symptoms would demonstrate a larger effect for depressive symptoms on episodic memory, as well as processing speed/shifting attention, found to be impaired in previous studies of older adults with major depression (Butters et al, 2004; Mantella, et al., 2007). The relationship of depression and anxiety to cognitive function, however, may be very different in normal older adults than in patients with clinically diagnosed anxiety or depression. For example, in contrast to our own findings, improved inhibitory ability was recently observed in older adults with clinically diagnosed Generalized Anxiety Disorder (GAD) (Price & Mohlman, 2007). The authors propose that worry in GAD serves as a coping strategy whereby verbal information, which is less arousing, is activated and visual information, which is more arousing, is inhibited. Enhanced inhibition in those with diagnostic anxiety could be costly if more cognitive resources are allocated to inhibition instead of other tasks. A curvilinear relationship may exist between inhibition and late-life anxiety—with enhanced inhibitory ability for those with higher levels of anxiety, and impaired inhibitory ability for those with mild symptoms, as in the current study. Our focus, however, was not on older psychiatric patients, but normal older adults reporting mild anxiety and depression.

We also observed coexisting anxiety and depressive symptoms to be associated with lower performance on 3 out of five cognitive domains (semantic memory, episodic memory, and processing speed/shifting attention) suggesting that their co-occurrence is associated with deficits in more cognitive domains. Studies that have previously reported general deficits in depression, but have not statistically adjusted for anxiety symptoms, may capture general deficits due to both depression and anxiety symptoms. At least one recent study of older psychiatric patients found significant overlap in cognitive deficits in a small clinical sample with either GAD or major depression, although a few cognitive deficits were specific to GAD or depression (Mantella et al., 2007). Some researchers postulate that the higher order construct of negative affect best characterizes the relationship between anxiety and

depression. By using a more refined approach in the current study, however, we found that anxiety symptoms were focally associated with poorer inhibition; this information would have been lost using a unitary construct approach.

The present study has some limitations. Results are limited to general anxiety symptoms and do not address specific anxiety symptoms, such as worry. Also, the extent to which older adults underreport symptoms are unknown, thus it is possible that a few participants in our study had a psychiatric disorder despite a negative psychiatric screen. Further, this study is unable to disentangle the influence of test anxiety on cognitive performance; although, there is some evidence in the older adult literature that anxiety is stable over time (Lovidband, 1998; Wetherell et al., 2001). Finally, challenging cognitive measures, such as the ones used in this study, measure multiple underlying abilities—not only the domain of interest. To further elucidate the neurocognitive influence of anxiety and depression in older adults, future studies should examine additional cognitive domains, such as working memory, other areas of executive function (e.g., abstract reasoning), or other tests of inhibitory ability for continued theory development and characterization of late-life anxiety symptoms. Experimental measures are also needed to isolate which of the multiple underlying abilities involved in inhibition are associated with anxiety and cognitive performance in older adults, before and after exposure to negative stimuli. The potential moderating effect of worry on general anxiety symptoms also deserves examination. To examine moderators and mediators of this association, temporal precedence in a longitudinal design is needed. The cross-sectional design for this study, although revealing based on our detailed analysis of cognitive measures, limits interpretation of potential causal mechanisms. Based on the differential findings from our investigation and some involving clinical populations, future studies may also want to consider the full spectrum of anxiety and depressive symptoms in order to better characterize their relationship to cognitive functioning. To summarize, this is the first study to our knowledge to demonstrate focal reductions in cognition in relation to milder anxiety symptoms in a large, non-psychiatric sample of community-dwelling older adults. Focal inhibitory deficits associated with increased anxiety, as well as deficits in a broader range of cognitive domains in the presence of coexisting mild anxiety and depressive symptoms, suggest that anxiety or mood symptoms insufficient to meet criteria for a psychiatric disorder are an important potential source of unaccounted for variance that could moderate cognitive performance in cognitive aging research. A strength of this study is the use of challenging cognitive tests sensitive to subtle cognitive deficits. This is important because many cognitive aging investigations recruit highly educated older adults (as we did) who may perform in the normal range on less challenging cognitive tests despite existing cognitive deficits. Whether inhibition can be improved with treatment for anxiety or with cognitive training of inhibitory abilities remains to be explored. An important next step for this area of research is refined analysis of anxiety symptoms implicated in reduced inhibitory ability, and secondary analysis of biological and genetic moderators of their relationship.

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Table 1

Mean, Standard Deviation, and Minimum/Maximum Total Scores on Mood, Anxiety, and Cognitive Tests in 120 Community Dwelling Older Adults

Variable	<i>M</i> (<i>SD</i>)	Min – Max
Depressive symptoms	5.23(4.97)	0 – 28
Anxiety symptoms	5.64(5.83)	0 – 31
Episodic memory	8.11(3.48)	0 – 15
Inhibition	140.92(35.21)	74 – 270
Processing speed/Shifting Attention	47.41(7.77)	27 – 69
Word fluency	47.18(13.51)	17 – 79
Semantic memory	55.97(5.24)	35 – 60

Note. Depressive symptoms = Geriatric Depression Scale; Anxiety symptoms = Beck Anxiety Inventory; Delayed episodic memory = Rey Auditory Verbal Learning Test Long Delayed Recall; Inhibition = Stroop Color and Word Test interference (sec); Processing speed/Shifting attention = Symbol Digit Modality Test; Word fluency = Controlled Oral Word Association Test; Semantic memory = Boston Naming Test—2nd Version. Unit of measurement for all neuropsychological tests was number of items correct, except for the Inhibition Task for which time to complete (seconds) is the outcome.

Table 2

Beta Coefficients and R² values for Anxiety Symptoms, Depressive Symptoms, and their Interaction on 5 Cognitive Domains

Cognitive Domains					
	Episodic Memory	Inhibition	Processing Speed/ Shifting Attention	Word Fluency	Semantic Memory
Step 1					
Anxiety (A)	.04	.38*	-.35*	.03	-.05
Depression (D)	-.25	-.18	.07	-.09	-.11
R ²	.06	.11	.11	.01	.01
Step 2					
A × D	-.32*	.02	.26*	-.15	-.33*
R2 Δ	.05	.00	.03	.01	.05

* Note. *p* < .05.