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The Relationship between Age and Affective Reactivity in Depressed and Healthy Females Across the Lifespan

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Abstract

Objective: Depression-related differences in processing emotional information have been observed in prior research, though the influence of age upon affective reactivity of negative, neutral, and positive stimuli may partially explain these differences. We examined the extent to which age influences affective reactivity to positive, neutral, and negative stimuli in depressed and healthy participants.

Methods: The study enrolled 129 right-handed females between 16 to 63 years old who met either DSM-IV criteria for current, medication-free Major Depressive Disorder (n=59) or no current or lifetime diagnoses (n=70). All participants completed a structured clinical interview for DSM-IV Axis I disorders, a clinical interview to determine depression severity, and an affective reactivity task.

Results: There were no significant main effects of depression status or interaction effects between depression status and age on ratings of positive, negative, and neutral stimuli. Additionally, there was no significant main effect of age on ratings of positive stimuli. However, there were main effects of age on ratings of negative and neutral stimuli suggesting that depressed and healthy participants differed in their evaluation of negative and neutral information as a function of age. Specifically, participants rated neutral information as more positive over the lifespan, and negative information as less negative across the lifespan.

Conclusion: Reactions to neutral information appear to become more positive with older age and reactions to negative information appear to decline with age unrelated to depression status.

Introduction

Research suggests that aging accompanies changes of emotional responses, with greater responsiveness to positive and neutral information [1] and decreased reactivity to negative information [2]. Laura Carstensen's emotional selectivity theory states that people tend to prefer positive to negative information as they age. Specifically, Carstensen et al. [1] reported that, at least until very late in life, healthy older adults report lower levels of depressive symptoms and higher levels of subjective well-being. These findings are surprising because old age is stigmatized as a time of practical and health complications, and cognitive declines are evident in older adults [3], suggesting vulnerability to emotional disorders.

Emotion and cognitive systems are closely linked across the lifespan. Age-related changes in cognition include a reduction in processing speed, episodic memory, and executive functioning; specifically problem solving and inhibitory control [4-7]. Moreover, five percent of the United States population between 65-69 years of age show moderate or severe memory impairment and 32% of those 85 years and older show moderate or severe memory impairment [8].

Cognitive declines are generally viewed as the consequence of an aging brain [9], whereas the improved affect associated with aging has been attributed to changes in motivation derived from differences in the perspective of time [1]. According to Carstensen's socioemotional selective theory, people have a sense of their time left in life, and the perceptions of time boundaries lead to directed attention toward emotionally meaningful aspects of life. When time is perceived as abundant, an individual's motivation and goals center on acquiring new information, expanding horizons and pursuing achievements. When

time is perceived as limited, positive emotional experience becomes the preeminent motivation, and the individual tunes attentional cognitive and social investments to enhance emotional closeness and positive affect. There is considerable evidence consistent with the predictions of socioemotional selectivity. In an illustrative study, Nolen-Hoeksema and Ahrens [10] investigated the levels of depressive symptoms in 25- 35 year old, 45-55 year old, and 65-75 year old adults. These groups were selected to represent different life circumstances and social histories. Results indicated that as a group, older adults reported the lowest levels of depressive symptoms. Despite age-related declines across cognitive functioning domains, research has shown that emotion regulation abilities improve with age [11]. Additionally, with increasing age recollections of past events are disproportionally more positive than negative.

Research indicates a 16.5% prevalence rate of adults who will experience major depressive disorder in their lifetime [12] and 6.7% in the last 12 months [13]. Depression is associated with blunted emotional

reactivity to positive and negative information [14,15]. The objective of the current study was to examine the extent to which reactivity to emotional stimuli differs as a function of age among participants with and without depression. If differences emerge as a function of depression then we know that depression is primarily accounting for the emotional processing changes. However, if differences emerge as a function of age, then we know that as we grow older our reactions to negative and/or positive stimuli may amplify or attenuate potentiating changes in behavior. We anticipated that age would influence processing of emotionally salient stimuli in both depressed and healthy participants.

Methods and Materials

IRB approval was issued by Northwestern University and remained current through the study.

Participants

Participants included 70 healthy controls (M(SD) age=36y(14.1y)) and 59 participants (M(SD) age=35.3y(14y)), diagnosed with DSM-IV major depressive disorder [16] using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID), [17] and scoring ≥ 24 on the Inventory of Depressive Symptomatology-Clinician Rated (IDS-C) [18]. Eleven depressed participants were diagnosed with comorbid anxiety disorders. Control participants reported no history of current presence of psychiatric disorders using the SCID and an IDS-C score ≤ 11. Participants also completed the Inventory of Depressive Symptomatology-Self Report (IDS-SR) version. Eligible participants passed a urine toxicology screen and had no history of head trauma or neurological conditions. Additionally, participants were medically

healthy and medication-free with no washout of medications, right-handed, and with normal vision. Depressed participants had no history of bipolar I or II psychosis, obsessive-compulsive disorder, posttraumatic stress disorder, substance abuse or dependence within six months of study participation, and specific personality disorders (e.g., borderline, schizoid, schizotypal and antisocial).

Procedure

Participants were screened by phone for initial eligibility and then invited for an on-site evaluation. The clinical assessment comprised of diagnostic and symptom severity interviews and completion of the behavioral affective task. Compensation and debriefing were offered upon completion. Of the volunteers screened (N=1,578), 213 female participants were invited to the lab, and 132 presented on site and enrolled.

Diagnostic and symptom measures

To determine psychiatric history, trained doctoral students administered the SCID [17]. Inter-rater agreement estimations were sufficient (e.g., kappa coefficients of .83 for the Mood module and .93 for the Anxiety module). To assess symptom severity, the 30-item IDS-C [19,20] was administered. Cronbach alpha coefficients for the IDS-C were .66 for the depressed group and .56 for the healthy group.
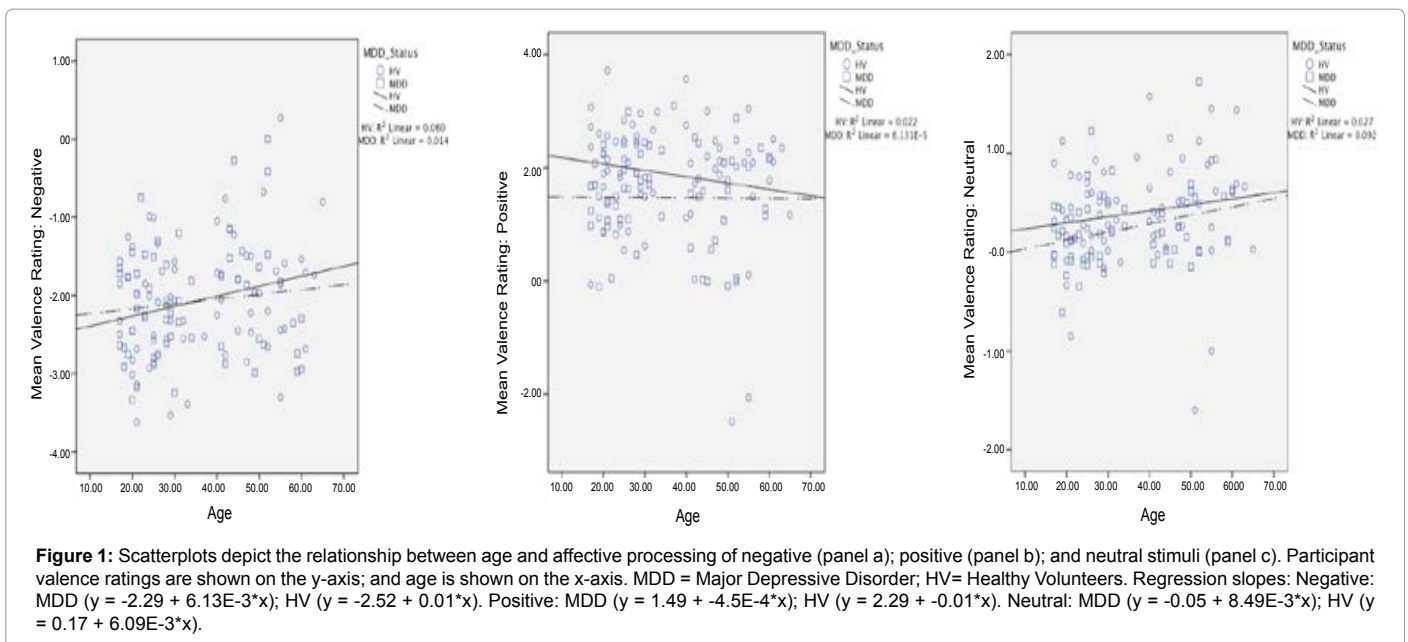
Affective reactivity task

Stimuli materials: Valence ratings were quantified using a set of standard affective images (e.g., International Affective Picture System [IAPS] [21,22]). Stimuli were color photographic images with varied emotional content. The three stimuli categories based on normative

		Healthy (*n* = 70)	Depressed (*n* = 59)	Total (*N* = 129)
		Mean (SD)	Mean (SD)	Mean (SD)
Age		35.96 (14.10)	34.61 (13.90)	35.34 (13.97)
IDS-C*		3.27 (3.00)	35.53 (8.37)	18.02 (17.23)
IDS-SR*		4.26 (3.27)	37.08 (8.92)	19.27 (17.64)
		Frequency n (%)	Frequency n (%)	Frequency n (%)
Ethnicity				
	White	41 (58.6)	36 (61.0)	77 (59.7)
	African American	25 (35.7)	18 (30.5)	43 (33.3)
	Other	3 (4.3)	3 (5.1)	6 (4.7)
	Unreported	1 (1.4)	2 (3.4)	3 (2.3)
Education				
	Under 7 Years of Schooling	0 (0.0)	1 (1.7)	1 (0.8)
	Partial High School	3 (4.3)	6 (10.2)	9 (7.0)
	High School Graduate	9 (12.9)	7 (11.9)	16 (12.4)
	Partial College	18 (25.7)	22 (37.3)	40 (31.0)
	University Graduate	25 (35.7)	17 (28.8)	42 (32.6)
	Graduate Training	15 (21.4)	6 (10.2)	21 (16.3)
Marital status				
	Never Married	39 (55.7)	38 (64.4)	77 (59.7)
	Married	19 (27.1)	8 (13.6)	27 (20.9)
	Separated	1 (1.4)	2 (3.4)	3 (2.3)
	Divorced	10 (14.3)	11 (18.6)	21 (16.3)
	Widowed	1 (1.4)	0 (0.0)	1 (0.8)

Note: * denotes significance at the p < .05 level. SD = standard deviation; IDS-C = Inventory of Depressive Symptomatology – Clinician Rated; IDS-SR: Inventory of Depressive Symptomatology – Self Report

Table 1: Clinical and Demographic Characteristics.

Figure 1: Scatterplots depict the relationship between age and affective processing of negative (panel a); positive (panel b); and neutral stimuli (panel c). Participant valence ratings are shown on the y-axis; and age is shown on the x-axis. MDD = Major Depressive Disorder; HV= Healthy Volunteers. Regression slopes: Negative: MDD (y = -2.29 + 6.13E-3*x); HV (y = -2.52 + 0.01*x). Positive: MDD (y = 1.49 + -4.5E-4*x); HV (y = 2.29 + -0.01*x). Neutral: MDD (y = -0.05 + 8.49E-3*x); HV (y = 0.17 + 6.09E-3*x).

valence ratings were Pleasant, Neutral and Unpleasant. There were two picture sets with similar normative valence and arousal ratings[1].

Experimental design and valence ratings: The affective reactivity task comprised 240 trials (80 unpleasant, 80 neutral, 80 pleasant images), presented randomly, on a 17 inch Samsung computer monitor. Participants were sitting approximately 45 centimeters from the screen. Each trial started with a white fixation point on a black screen for 500 ms followed by the display of the image in the middle of the screen for up to 4000 ms and lastly followed by a self-paced rating period showing the Evaluative Space Grid (ESG). The ESG is a 5 (positive: *not at all to extremely*) by 5 (*negative: not at all to extremely*) matrix [23] with positive valence reflected on the horizontal axis and negative valence on the vertical axis. Participants were instructed to move their mouse to one of the 25 cells in the 5 x 5 matrix and click on the box that indicates the intensity of their positive and negative feelings. The affect matrix is preferable to existing unipolar measures because it simplifies the rating procedure for participants. Rather than asking two or more questions about each stimulus, the affect matrix requires one rating, making it especially advantageous when participants are required to rate multiple stimuli.

GLM ANCOVA

To determine the impact of depression status and age on valence ratings, we conducted three between-subjects analyses of covariance (ANCOVA) on valence ratings of negative, positive, and neutral stimuli with depression status (depressed, non-depressed) as the independent variable and age as the covariate. Assumptions of normality of sampling distributions, linearity and homogeneity of variance were

[1]The picture numbers for IAPS stimuli are available upon request. The standard valence and arousal ratings for each of the two picture sets are: Odd assigned subject numbers: Valence: Negative M = 3.06 (SD = 0.47), Neutral M = 5.12 (SD = 0.38), Positive M = 6.93 (SD = 0.43); Even numbers valence: Negative M = 3.02 (SD = 0.52), Neutral M = 5.06 (SD = 0.36), Positive M = 6.96 (SD = 0.47). Odd subjects arousal: Negative M = 5.17 (SD = 0.72), Neutral M = 3.37 (SD = .51), Positive M = 5.09 (SD = 0.55); Even subjects arousal: Negative M = 5.18 (SD = 0.71), Neutral M = 3.42, (SD = 0.57), Positive M = 5.22 (SD = 0.70).

met. Scatterplots were used to test the assumption of homogeneity of the regression slopes and depict the relationship between the covariate age and affective processing of negative, positive, and neutral stimuli (Figure 1).

Results

Participant characteristics

Demographic characteristics of the two groups (depressed and healthy participants) and statistical analyses to evaluate group differences are presented in Table 1. In brief, we conducted tests of baseline differences in demographic and clinical characteristics using GLM Analysis of Variance (ANOVA) for continuous variables and Chi-square tests of independence for categorical variables. Groups were similar in ethnic composition, educational attainment and marital status. Chi-square analyses revealed no group differences on demographic characteristics. As expected, the groups showed significant group differences on depression severity with depressed participants showing greater clinician-rated and self-reported depressive symptom severity than healthy participants (Table 1).

GLM ANCOVA results

ANCOVA analyses on affective processing of negative stimuli revealed no main effect of depression status: $F(1, 125)=0.424$, p=0.516, $\eta^2=0.003$. Conversely, there was a main effect of the covariate age: $F(1, 125)=4.211$, $p=0.042$, $\eta^2=0.033$. The interaction between depression status and age was not significant: $F(1, 125)=0.519$, $p=0.473$, $\eta^2 =0.004$.

The ANCOVA on affective processing of positive stimuli revealed no main effects of depression status: $F(1, 125)=3.064$, $p=0.082$, $\eta^2=0.024$ or age: $F(1, 125)=0.930$, $p=0.337$, $\eta^2=0.007$. Additionally, the interaction between depression status and age was not significant: $F(1, 125)=0.792$, $p=0.375$, $\eta^2 =0.006$.

Finally, ANCOVA analyses on affective processing of neutral stimuli showed no main effect of depression status: $F(1, 125)=1.043$;

p=0.309, η^2=0.008. Conversely, there was a main effect of the covariate age: $F(1, 125)$=6.191, p=0.014, η^2=0.047. The interaction between depression status and age was not significant $F(1, 125)$=0.169, p=0.682, η^2=0.001.

Discussion

This study investigated the extent to which there were differences in the evaluation of negative, neutral, and positive stimuli as a function of age and depression status. Participants were exposed to emotionally-laden images and were asked to rate their affective reactions. Thus, one could look at differential reactivity as a function of age, specifically, how age influenced the evaluation of positive, negative, and neutral stimuli rather than their preferential selection, or "differential exposure" to positive, neutral, or negative stimuli/environments. It is important to distinguish between differential reactivity, which was the focus in the current study, and differential exposure, which has been the focus in much of the prior work. If age is related to a greater likelihood of approaching, thinking about, and interacting with positive stimuli (i.e., differential exposure), then these stimuli may also be better recalled as demonstrated in prior research [24,25]. Overall, our results revealed that older age was associated with a decline in reactivity to negative stimuli and an increase in reactivity to neutral stimuli unrelated to depression status.

Carstensen's theory has primarily been applied to healthy adults wherein aging is associated with increased responsiveness to positivity. However, major depression is characterized as a heterogeneous condition associated with significant alterations in expressed affective reactivity [14,15] and thus may further impact the relationship between affective reactivity and aging. Our findings add to the literature by demonstrating that age-related changes in affective reactivity occur similarly in depressed and healthy women, emphasizing the importance of aging over depression status. It will be important to assess whether the experience of depression changes as a function of age and the consistency of affective reactivity in late-life depression (e.g., individuals older than 65 years). These findings suggest that a detailed investigation of the evaluative preferences of women with and without depression over the lifespan may refine our understanding of affect processes among women.

The current study has several strengths and limitations. Strengths include the focus on the role of age on affective processing in clinically depressed samples and healthy controls, the use of an unmedicated sample with no comorbid medical conditions, and categorical and continuous assessments of symptoms ensuring a multi-method evaluation. Limitations include the use of a task that asked for bivalent ratings (e.g., rate both positive and negative valence at the same time) which cannot yet be employed in a clinical setting. Another limitation pertains to the focus on chronological age versus time perspective. Lockenhoff and Carstensen [26] argue that understanding one's subjective experience of time left in life and affective experiences characterizing that experience is important and this study only employed chronological age to examine affective processing across the lifespan. Additionally, affective stimuli used in the study may be insufficiently representative of different scenarios spanning across the lifespan.

In sum, our study suggests that the processing of emotional stimuli remains similar throughout the lifespan for positive information, but differs as a function of age for neutral and negative information for both healthy and depressed adults. More specifically, these findings suggest that aging is associated with altered affective asymmetry to neutral and negative emotional information that may be associated with a more positive response to neutral information and a less negative response to negative information, which may contribute to a preferential 'selection' of positive information with aging proposed by Carstensen. This study offers unique contribution to understanding the role of aging in affective processing of women across the lifespan. Future work should assess differences in affective reactivity later in the perceptual processing stream to determine the impact of cognitive demands on emotional processing.

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