The Correlation Between Impaired Attention and Emotional Reactivity in Depressed Adolescent Patients

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A group of 20 drug-naïve depressed adolescents and 20 matched controls underwent cognitive evaluations and assessment of emotional reactivity. Emotional reactivity correlated only with attention and only in depressed patients. The cognitive–emotional construct may enhance the understanding of adolescent depression and aid diagnosis.

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Major depression in adolescents is common, frequently severe, and potentially life-threatening.[1] Further research on the cognitive impairments in sufferers may lead to a better understanding of both the challenges faced by patients and the illness course, as well as aid diagnosis.[1–5] Studies have consistently demonstrated cognitive slowness, impaired attention, and greater impulsivity in depressed teenagers.[2–5] Difficulties with working memory, spatial memory, planning, and set-shifting have also been found, but are controversial.[3,4]

The term "emotional reactivity" denotes the characteristics of emotional responding, and includes the extent of emotional response, intensity of various components of the response, and threshold of stimuli needed to generate a response.[6–8]

Emotional reactivity is attracting increasing interest as a marker in depression, with recent data suggesting it may have prognostic significance.[7] The three major views regarding emotional reactivity in depression are 1) negative potentiation (in depression, stimuli that have a negatively valence produce an extenuated emotional reaction); 2) positive attenuation (stimuli that have a positive valence are appreciated less); and 3) "emotion context insensitivity" (ECI; the effect of all stimuli is diminished).[6]

Many of the studies evaluating emotional reactivity have used measures of executive function during an emotional task. Attentional bias tasks such as the "emotional Stroop" and "affective Go/No-Go" paradigm have been used. Bias is indicated by facilitation of reaction time by emotional valence.[8]

To the best of our knowledge, no previous study has evaluated the relationship between emotional reactivity and other cognitive functions in depressed adolescents. Attention is central to reactivity. We hypothesized that difficulty in attention is the only cognitive deficit that correlates with the depressed pattern of emotional reactivity.

METHODS

The study was approved by the local Institutional Review Board. All subjects and parents gave written informed consent to participate.

Subjects

Twenty antidepressant-naïve adolescent patients with major depression who were scheduled to begin a fluoxetine regimen through their treating psychiatrist were included. Patients were reevaluated by a senior child and adolescent psychiatrist, who confirmed the diagnosis.

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Evaluation also included the Children's Depression Rating Scale-Revised (CDRS-R)[9] and Beck Depression Inventory (BDI) for youth ≥13 years.[10] Suicidality was ascertained with the Suicide Ideation Questionnaire (SIQ).[11] Exclusion criteria were psychosis, bipolar disorder, current substance abuse, mental retardation, and major neurological disorder. The patients were recruited from Shalvata Mental Health Center (17 from the outpatient clinic and 3 from the adolescent ward).

The control group comprised 22 healthy adolescents matched for age and gender. The Brief Symptom Inventory (BSI)[12] was used to verify the absence of mental disorder. Two adolescents were excluded because of their BSI result.

Cognitive Assessment

All participants (depressed and control) underwent cognitive assessment, using the Cambridge Neuropsychological Test Automated Battery (CANTAB). This is an extensively-validated battery sensitive to cognitive changes caused by a wide range of CNS disorders and medication effects.[13,14] The following component tests have assessed the described cognitive domains in previous studies of major depression:

Motor Task (MOT): psychomotor speed. A series of crosses is shown in different locations on the screen.

Rapid Visual Processing (RVP): sustained attention. The subject is required to detect three target sequences of three digits each among serially appearing digits. The task is in essence a Continuous Performance Test, a frequently used measure of attention highly sensitive to brain damage or dysfunction.

Match to Sample Visual Search (MTS): visual-spatial attention. This is a simultaneous visual search task with response latency dissociated from movement time.

Paired-Associates Learning (PAL): visual memory and learning. Subjects are required to locate the placement of previously presented designs.

Stockings of Cambridge (SOC): cognitive planning. The subject attempts to solve a problem by moving colored balls in as few moves as possible.

Spatial Working Memory (SWM): This search task assesses both mnemonic and strategic aspects of working memory.

Spatial Span (SSP): This is a test of spatial short term memory that examines the ability to remember the location of sequentially presented stimuli.

Intra-Dimensional-Extra-Dimensional (ID-ED) shift: cognitive shifting. This is a visual discrimination task requiring set learning, reversal learning, and an extra-dimensional set shift.

Emotional Reactivity Assessment

The International Affective Picture System (IAPS) was used to evaluate emotional reactivity. The IAPS uses a series of emotional, normative, and internationally-accessible pictorial stimuli. Based on previous studies in depressed patients,[15] we used 40 pictures that tapped either positive or negative valence. Each picture was presented for 6 seconds; the patient then had 15 seconds to rate the picture on a scale of 1 (Extremely Sad) to 10 (Extremely Happy).

Data Analyses

Independent-sample *t*-tests (two-tailed) were used to analyze differences between groups in the studied variables (cognitive performance and emotional reactivity). Relationships between the cognitive measures and emotional reactivity were analyzed with Pearson correlations. SPSS Version 17 was used for statistical analyses.

RESULTS

Sample Characteristics

Information about patients' age and gender is presented in Table 1. For 14 patients, this was the first depressive episode, and, for 6, the second episode. The current episode length was 1–24 months (mean: 9.02; standard deviation [SD]: 7.75). Comorbidity included attention-deficit hyperactivity disorder (ADHD; 4 patients, of whom 2 were continuously on methylphenidate), learning disorders,[2] gender-identity disorder,[1] and past history of substance abuse.[4] The vast majority of patients (17) were students in the general educational system. Two were in special education, and one had dropped out of school.

Cognitive Functioning

The group of patients with depression showed deficits in some, but not all, areas of cognitive functioning when compared with matched healthy controls (Table 1). The depressed group performed worse in the following tasks: psychomotor speed (MOT, p=0.02); attention (RVP-A, p=0.008); sustained attention (RVP mean latency, p=0.01); and visual-spatial attention (MTS mean correct latency, p=0.06, but not in MTS % correct[NS]); visual memory (PAL total errors adjusted, p=0.04; PAL stage completed on the first trial, p=0.03); cognitive

TABLE 1. Demographic Features, Cognitive Functions, and Emotional Reactivity of Depressed Versus Control Adolescents

	Depressed Patients, mean (SD), N	Healthy Controls, mean (SD), N	Statistical Test (df)	p	Effect size (r)
Age, years	15.42 (1.35), 20	15.75 (1.83), 20	$t_{(38)}$= –0.64	NS	N/A
Gender	5M/15F	6M/14F	$\chi^2_{(1)}$=0.12	NS	N/A
CDRS	64.1				
	10.3				
BDI	30.8				
	6.3				
SIQ	120.3				
	47.3				
BSI	0.4				
	0.2				
Psychomotor Speed					
MOT response latency	805.48 (208.64), 20	671.26 (140.05), 20	$t_{(38)}$=2.39	0.02*	0.36
Sustained Attention					
RVP-A	0.87 (0.05), 18	0.92 (0.04), 20	$t_{(36)}$=–2.79	0.008**	0.42
RVP mean latency	505.71 (108.67), 18	431.67 (0.44), 20	$t_{(36)}$=2.51	0.01*	0.39
Visual-Spatial Attention					
MTS mean correct latency	1891.08 (719.26), 20	1542.06 (358.99), 20	$t_{(28)}$=1.94	0.06	0.34
MTS % correct	96.04 (4.72), 20	95.73 (4.61), 20	$t_{(38)}$=0.21	NS	0.03
Visual Memory and Learning					
PAL stages completed on first trial	5.78 (0.97), 14	6.55 (1.00), 20	$t_{(32)}$=–2.21	0.03*	0.36
PAL total errors, adjusted	18.78 (24.52), 14	3.60 (3.39), 20	$t_{(14)}$=2.3	0.04*	0.52
Cognitive Planning					
SOC initial thinking time	6974.88 (4919.12), 20	12297.63 (8565.71), 20	$t_{(38)}$=–2.41	0.02*	0.36
SOC subsequent thinking time	1164.83 (963.58), 20	534.51 (584.35), 20	$t_{(38)}$=2.50	0.02*	0.38
SOC number of problems solved in minimum move	7.8 (2.46), 20	9.95 (1.70), 20	$t_{(34)}$=–3.21	0.003**	0.48
Working Memory					
SWM between errors	29.9 (21.64), 20	12.70 (14.39), 20	$t_{(33)}$=2.95	0.006**	0.46
SSP span length	6.5 (1.35), 20	7.15 (1.27), 20	$t_{(38)}$=–1.56	0.12	0.25
Cognitive Shifting					
IED number of total errors (adjusted)	29 (22.87), 12	29.1 (24.69), 20	$t_{(30)}$=–0.01	NS	0.00
IED number of stages completed	8.33 (0.98), 12	8.35 (0.93), 20	$t_{(30)}$=–0.21	NS	0.04
Emotional Reactivity					
Positive valance	5.95 (0.81), 20	6.76 (0.85), 20	$t_{(38)}$=–3.09	0.004**	0.45
Negative valance	6.53 (0.94), 20	6.10 (0.42), 20	$t_{(26)}$=1.86	0.07	0.34
Overall valance	6.25 (0.72), 20	6.43 (0.52), 20	$t_{(38)}$=–0.95	NS	0.15

CDRS: Children's Depression Rating Scale; BDI: Beck Depression Inventory; SIQ: Suicide Ideation Questionnaire; BSI: Brief Symptom Inventory; MOT: motor task; RVP: Rapid Visual Processing; MTS: Match-To-Sample visual search; PAL: Paired-Associates Learning; SOC: Stockings of Cambridge cognitive planning test; SWM: Spatial Working Memory; SSP: Spatial Span; ID-ED: Intra-Dimensional-Extra-Dimensional shift.
*Significant at the 0.05 level (two-tailed).
**Significant at the 0.01 level (two-tailed).

planning (SOC problem solved in minimum moves, p=0.003; SOC subsequent thinking time in 5 moves, p=0.017; SOC initial thinking time in 5 moves, p=0.02); and in spatial working memory (SWM between errors, p=0.006), but not in other aspects of working memory (SSP Span length [NS]). No difference was found in cognitive flexibility (ID-ED stages completed [NS]; ID-ED total errors adjusted [NS]).

Emotional Reactivity

There were significant differences in emotional reactivity between the two groups: compared with healthy controls, the depressed group reported on the positive stimuli as less positive (p=0.004) and showed a trend to perceive negative stimuli as more negative (p=0.07).

Cognitive–Emotional Reactivity Correlation

In the depressed group, emotional reactivity was correlated with a measure of attention, as indicated by the positive correlation between both positive and negative valence and RVP mean latency (r=0.48, $p < 0.05$; r=0.51, $p < 0.05$; respectively). In the control group, no such correlation was found. No other cognitive measure correlated with emotional reactivity.

DISCUSSION

This is the first study to systematically examine correlations between emotional reactivity and cognitive functioning in depressed adolescents.

Consistent with the current literature,[3–5] our findings included problems in planning, learning, speed, and attention, but not set-shift, in the depressed group. More importantly, however, we found a dichotomy between the depressed and control groups in the correlation between emotional reactivity and cognitive functions: In the depressed group, emotional reactivity was correlated only with a measure of attention for both positive and negative valence stimuli, whereas, in the control group, no such correlation was found. This result cannot be explained by a lack of general attention, as the depressed group assessed the pictures with the negative valence as more negative than the control group. In previous studies of depressed adolescents, attention was suggested to be a state-marker for depression.[5] Similarly, emotional responsiveness changes over the illness course and is also possibly state-dependent. The construct of emotions is distinct from mood by presenting a dynamically-responsive, quickly-changing component to external meaningful stimuli. Perhaps that is why, in the present study, attention was the only cognitive measure that correlated with emotional reactivity. Attention is necessary for the perception of the stimuli itself. The correlation between these two measures supports the hypothesis that they are state-markers of depression.[6]

If our findings are replicated with a larger sample, the combined measure may serve to improve knowledge about a specific malfunction in depression. Pairing of attention and emotional reactivity tasks may also prove a better aid for diagnosis of the illness than previously-suggested separate tools, such as attention difficulties or problems with emotional reactivity. Longitudinal study of the same depressed adolescent patient group, while depressed and in recovery, will help clarify the state-versus-trait question

Study limitations include the small sample size, the fact that diagnosis was based on two clinical evaluations without a structured interview, and the heterogeneity of the depressed group.

In conclusion, the study's main finding is in the specificity of pairing of attention and emotional reactivity in depressed adolescents. This has potential implications for both elucidating the impairments from which depressed adolescents suffer and improving diagnosis.

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