University of Cincinnati

Date: 7/20/2017

I, Sara Ebner, hereby submit this original work as part of the requirements for the degree of Master of Arts in Psychology.

It is entitled:
Affective Contributions to Rapid Automatized Naming in a College Sample Referred for Learning Difficulty

Student’s name: Sara Ebner

This work and its defense approved by:

Committee chair: Quintino Mano, Ph.D.

Committee member: Chung-Yiu Peter Chiu, Ph.D.

Committee member: Kristen Jastrowski Mano, Ph.D.
Affective Contributions to Rapid Automatized Naming

Affective Contributions to Rapid Automatized Naming in a College Sample Referred for Learning Difficulty

A thesis submitted to the
Graduate School
of the University of Cincinnati
in partial fulfillment of the
requirements for the degree of

Master of Arts

in the Department of Psychology
by

Sara Ebner

B.S. University of Cincinnati
July 2017

Committee Chair: Quintino R. Mano, Ph.D.
Affective Contributions to Rapid Automatized Naming

Table of Contents

Abstract............................................................................................................3

Reading and Emotion......................................................................................5-6

Rapid Automatized Naming (RAN) .................................................................6-8

Present Study..................................................................................................8-9

Method...........................................................................................................9-12

Results...........................................................................................................12-14

Discussion.....................................................................................................14-17

References.....................................................................................................18-19

Tables.............................................................................................................20-27
Affective Contributions to Rapid Automatized Naming

Abstract

While it is generally assumed that learning difficulties are the antecedent to affective problems, little is known about whether the reading-emotion association is bidirectional. If learning problems give rise to affective problems, then a subsequent question is whether affective problems, in turn, exacerbate reading difficulties. The purpose of the present study is to examine whether affective problems (i.e., anxiety, depression) predict unique variance in a critical reading skill (i.e., rapid automatized naming) above and beyond cognitive processing speed and basic reading skills (i.e., isolated word recognition, pseudoword reading) within a sample of adults referred for learning difficulty ($M = 25.97$ years; $SD = 9.4$).

Based on extant literature, it was hypothesized that affective processing would predict variance in rapid automatized naming (RAN) above and beyond control variables (i.e., cognitive processing speed, basic reading skills). Such an observation will broaden our understanding of the bidirectional relation between reading and affective processing. We used three hierarchical regressions to examine the contributions of cognitive and affective variables to each of the following RAN skills measured by RAN/RAS (Wolf & Denckla, 2005): (1) RAN-Object/Color, (2) RAN-Number/Letter, and (3) RAS/2-3Set. Participants completed all RAN/RAS subtests (RAN/RAS: Wolf & Denckla, 2005), the processing speed cluster of the Woodcock-Johnson Tests of Cognitive Abilities III (WJ-III COG: Woodcock, McGrew, & Mather, 2001a), the basic reading skills cluster of the Woodcock-Johnson Tests of Achievement III (WJ-III ACH: Woodcock, McGrew, & Mather, 2001b), and anxiety and depression subscales of the Personality Assessment Inventory (PAI: Morey, 1991).

Results from the hierarchical regression analysis showed that affective variables predicted significant variance in RAS/2-3Set (i.e., 16.8%), above and beyond contributions from cognitive processing speed and basic reading skills. Affective variables did not predict variance in any other RAN variable (i.e., RAN-Object/Color, RAN-Number/Letter). This finding is particularly notable because the RAS/2-3Set subtest is unique from the other two RAN subtests insofar as it includes an executive functioning component (e.g., mental set shifting). Contrary to our hypothesis, affective predictors did not account for unique variance above and beyond processing speed and basic reading skills in all RAN subtests. However, because affective predictors did account for such variance in the RAS/2-3Set subtest, it suggests that executive functioning plays a unique role in linking affective processing with reading. Broadly, present results suggest that affective processing may exert its effect “bidirectionally” onto reading when executive functioning is employed.

*Keywords*: rapid automatized naming (RAN), rapid alternating stimulus (RAS), executive functioning, processing speed, learning difficulties
Affective Contributions to Rapid Automatized Naming
Affective Contributions to Rapid Automatized Naming

Affective contributions to rapid automatized naming in a college sample referred for learning difficulty

Prior research on learning disabilities has been successful in describing and measuring cognitive functions relevant to academic learning but has paid relatively less attention to the possible emotional impact of such disorders (Arthur, 2003). Similarly, practicing psychologists have historically treated individuals with learning disabilities with a focus on assessing cognitive functioning, with an aim towards remediating cognitive and academic weaknesses. Thus, relatively less is known about the role that affect plays in reading, both as a consequent and as an antecedent. Research interest in the affective implications that co-occur with learning disabilities has recently increased with the growing awareness that individuals with learning disabilities are vulnerable to suffering from subsequent affective disorders (Arthur, 2003).

Accumulating evidence now suggests that individuals with learning difficulties are at increased risk for developing affective difficulties such as anxiety and depression (Gray et al., 1983; McKenzie et al., 2000; Whittington & Alexander, 2001; Arthur, 2003). The affective problems seen among people with learning disabilities may be broader than is currently suspected. For example, people with learning disabilities often display problems recognizing the affect of others, have difficulty coping with high-intensity emotions, and benefit from training in affective recognition (Gray et al., 1983; McKenzie et al., 2000; Whittington & Alexander, 2001; Arthur, 2003). It is generally assumed that learning difficulties are the antecedent to affective problems; however, little is known about whether the reading-emotion association is bidirectional. It is conceivable that affective problems also affect reading performance, creating a downward spiral of cognitive-emotional interactions that may go unnoticed during the clinical assessment process.
Affective Contributions to Rapid Automatized Naming

Studies have now established a reading-emotion association, but further research is needed to delve deeper into this relationship. If learning problems give rise to affective problems, then a next question is whether affective problems, in turn, exacerbate reading difficulties. This gap in current literature represents a lack of knowledge that is important for assessment and intervention of both learning difficulties and affective disorders. If affective problems indeed compound reading difficulties, then diagnosis and treatment planning for individuals with learning disabilities might be missing a crucial affective component of monitoring and remediation.

**Reading and Emotion**

Early identification of both reading and affective disorders is pertinent to the academic and social developmental wellbeing of students (Horn & Packard, 1985). For example, research shows that students who demonstrate early academic and learning difficulties are more likely to display later academic difficulties (i.e., school dropout) and be at risk of developing affective and behavioral disorders (Horn & Packard, 1985; Bennett et al., 2003; Moffit et al., 1981). Similarly, inefficient affective regulation has been shown to physiologically inhibit an individual’s use of higher order cognitive processes such as working memory, attention, and planning; highlighting the important juxtaposition of emotion and executive functioning. Individuals who display a lack of affective regulation may also lack the ability to engage in the learning process, thus resulting in later academic difficulties (Ladd, Birch, & Buhs, 1999; Ladd & Burgess, 2001). Because affective problems and academic difficulties can follow children into adulthood, it is important to keep a clinical eye open to these problems across the lifespan.

Students with learning disabilities display higher levels of self-reported fears and generalized anxiety compared to non-learning disabled students, which may contribute to
Affective Contributions to Rapid Automatized Naming

affective problems and challenging behaviors later in life (Ramirez & Kratochwill, 1997). Evidence shows that early identification partnered with targeted intervention improves reading ability as well as other potential adverse effects that individuals might carry into adulthood (Horn & Packard, 1985). Because assessment tools such as rapid automatized naming (RAN) exist that allow us to assess children before they are literate, those types of assessment tools represent ideal outcome variables in which to examine the association between reading and emotion. Indeed, such investigations may produce insights that translate into new clinical practices, such as identifying and treating affective contributions to the learning process in childhood.

**Rapid Automatized Naming (RAN)**

Learning difficulties often stem from a breakdown in the reading process. Reading requires a complex cognitive process that involves many component skills such as phonological processing, working memory, and semantic processing (Abu-Hamour, Urso, & Mather, 2012). The breakdown of any one of these skills can drastically increase the risk of developing learning and reading difficulties. When an individual is suspected of having reading difficulties, psychologists often utilize assessment tools such as RAN to pinpoint where the failure in the reading process lies. RAN is a clinical measure that involves the rapid naming of familiar stimuli and is often used for assessing reading difficulties because of its high predictive power of core reading outcomes such as isolated word recognition (Norton & Wolf, 2012).

Individuals who perform poorly in RAN are more likely to experience reading difficulty (Norton & Wolf, 2012; Wolf & Bowers, 1999). Because RAN requires many of the same cognitive processes involved within the natural reading experience, such as eye saccades,
Affective Contributions to Rapid Automatized Naming

working memory, and connection of orthography and phonology, it is broadly considered a “microcosm” of the reading process (Norton & Wolf, 2012). Also, RAN depends on automaticity (i.e., rapid and accurate recognition of stimuli) across each component in the naming circuit, much the same as reading. Evidence shows that difficulty with RAN explains unique variance in reading disability, above and beyond contributions from phonology and orthography (Wolf & Bowers, 1999). Because of these lines of research, RAN is subsequently thought to be a cognitive function semi-independent of phonology and orthography, a construct that stands on its own and that if impaired (or developmentally delayed) may give rise to reading disability.

In addition to deficits in RAN, deficits in processing speed have been hypothesized as a possible cognitive correlate of reading failure (Urso, 2008), particularly among adult readers (Swanson, 2012). Processing speed refers to how quickly and accurately an individual can carry out a simple cognitive task. Importantly, individuals with slow processing speed may perform poorly on tasks of automaticity, such as RAN, not because of difficulty in accurate stimulus recognition and phonological retrieval but because of generally slow processing speed. It is for this reason that studies on the relation between RAN and reading need to account for general process speed, to control for such a confound. For example, research suggests that general cognitive and motor processing speed—on a variety of linguistic and non-linguistic tasks—accounts for variance in both rapid (object) naming and broader reading achievement (Catts, Gillispie, Leonard, Kail, & Miller, 2002). Keeping this confound in mind, the present study sought to examine the reading-emotion association by characterizing the relation between affective processing and RAN, while controlling for variance associated with general processing speed.
Affective Contributions to Rapid Automatized Naming

**Present Study**

The overarching goal of the present study was to broaden our understanding of the reading-emotion association. Evidence already exists showing that individuals with learning difficulties are at increased risk for affective problems (Gray et al., 1983; McKenzie et al., 2000; Whittington & Alexander, 2001; Arthur, 2003); however, the question remains if affective problems also contribute to reading difficulties. The present study examined whether affective problems (i.e., anxiety, depression) explain unique variance in a key reading skill (i.e., RAN) above and beyond variance explained by general processing speed and basic reading skills (i.e., isolated word recognition, pseudoword reading).

The present study was carried out within a clinical sample of individuals referred for learning difficulty. We chose to use RAN as our reading measurement because it is considered to be a microcosm of basic reading skills (i.e., rapid visual recognition and phonological retrieval). Though few studies have examined this direction of the reading-emotion association, evidence has accumulated suggesting that poor affective regulation inhibits cognitive processes that are essential for learning and reading. Based on cited literature, it was hypothesized that affective processing would predict variance in RAN above and beyond control variables (i.e., cognitive processing speed, basic reading skills). Such an observation will increase our understanding of the bidirectional relation between reading and affective processing.

**Method**

**Participants**

Participants were 88 individuals (44 females; 44 males), age 18-58 years ($M = 25.97$ years; $SD = 9.4$), referred to a university-based learning disability clinic. Many of the individuals within the sample received psychiatric diagnoses (e.g., anxiety, depression), including specific
Affective Contributions to Rapid Automatized Naming

learning disabilities. Thirteen percent of participants were diagnosed with anxiety or a related disorder, 16% were diagnosed with depression or a related disorder, and 3% were diagnosed with comorbid anxiety and depression disorders. This study was approved by the University of Cincinnati Independent Review Board.

Measures

**RAN/RAS.** Participants completed the Rapid Automatized Naming/Rapid Alternating Stimulus Test (RAN/RAS: Wolf & Denckla, 2005). RAN/RAS is a clinical measure used to estimate an individual’s ability to rapidly recognize and name visual symbols, including colors, objects, numbers, and letters (see Figure 1). Each RAN test is comprised of five stimuli that randomly repeat ten times in an array of five rows. There are four RAN tests which involve the naming of letters, numbers, objects, or colors. There are two RAS subtests which involve the naming of letters and numbers (2-set), and the naming of letters, numbers, and colors (3-set). The RAS-2set test is comprised of ten stimuli that are randomly repeated in an array of five rows. The RAS-3set test is comprised of 15 stimuli that are randomly repeated in an array of five rows. There is a total of 50 stimuli in each RAN/RAS test which are read aloud in left-to-right serial fashion. The amount of time taken to accurately name all stimuli reflects RAN. The RAN/RAS test was normed on 1,461 individuals in 26 different states with test-retest reliability coefficients ranging from .84 to .92 for all age groups, as reported in the test manual (RAN/RAS: Wolf, Denckla, 2005).
Processing speed. Participants completed the Woodcock-Johnson Tests of Cognitive Abilities III Processing Speed cluster (WJ-III COG). The processing speed cluster includes visual matching in which participants must circle two identical numbers in each row of six numbers as quickly as possible for three minutes, and decision speed in which participants must find two pictures in each row that are most similar conceptually as quickly as possible for three minutes. The Woodcock-Johnson-III was normed with a nationally representative sample of 8,818 subjects. This processing speed subtest has test-retest reliabilities of .88-.91. The typical range of correlations for cognitive clusters is .20 to .60 (WJ-III COG: Woodcock, McGrew, & Mather, 2001a).

Reading. Participants completed the basic reading skills cluster of the Woodcock-Johnson Tests of Achievement III (WJ-III ACH) to measure sight vocabulary and the ability to apply phonic and structural analysis skills to reading. The basic reading skills cluster includes letter word recognition in which participants read words aloud from an increasingly difficult vocabulary list, and word attack in which participants read nonsense words (e.g., shleet, guddy) aloud. The letter word identification component assesses pronunciation while word attack assesses phonetic word attack skills. The Woodcock-Johnson-III was normed with a nationally representative sample of 8,818 subjects with a median reliability of .94 for adults. As reported
Affective Contributions to Rapid Automatized Naming

in the test manual, the typical range of correlations for achievement clusters that do not share common tests is .50 to .70 (WJ-III ACH: Woodcock, McGrew, & Mather, 2001b).

Affect. Participants completed the Personality Assessment Inventory (PAI) to assess personality and psychopathology. The PAI is a self-report clinical tool that provides information relevant for clinical diagnosis and screening for psychopathology. Cognitive, affective, and physiological subscales for both Depression and Anxiety scales were used as affective predictors in the present study (i.e., DEP-C, DEP-A, DEP-P, ANX-C, ANX-A, ANX-P, respectively). The interpretive significance of high scores on each of these subscales in presented in Tables 1 and 2. The PAI was nationally normed on over 3,000 adults of various clinical and community settings. Reliability studies show that the PAI has a high degree of internal consistency across samples (median alpha and test-retest correlations exceed .80 for the 22 scales). As reported in the test manual, the alpha coefficients of internal consistency for the 22 scales were median .81, median .82, and median .86 for the normative, college, and clinical samples (PAI: Morey, 1991).

Data Analysis

Three hierarchical linear regressions were employed to examine whether cognitive and affective scores predict unique variance in RAN above and beyond general processing speed and basic reading skills. A linear regression was conducted for each of the following dependent variables: (1) RAN-Object/Color, (2) RAN-Number/Letter, and (3) RAS/2-3Set. The independent variables entered into Step 1 were as follows: basic reading skills index (i.e., isolated word recognition, pseudoword reading), and cognitive processing speed index (i.e., visual matching, rapid picture naming). The cognitive, affective, and physiological PAI
Affective Contributions to Rapid Automatized Naming

subscales for both depression and anxiety scales were entered into Step 2, with the entry of these six predictor variables the same for each of the three RAN/RAS dependent variables.

Results

Preliminary Analyses

Distributional properties for all measures are presented in Table 3. As expected, processing speed was significantly correlated with all RAN/RAS subtests (see Table 4). Notably, basic reading skill was only significantly correlated with the RAS/2-3Set subtest, \( r(85) = .21, p = .02 \).

Anxiety and RAN/RAS

As shown in Table 4, the cognitive anxiety subscale correlated negatively and significantly with both RAS/2-3Set subtest (\( r = -.199, p = .031 \)) and basic reading (\( r = -.201, p = .031 \)), indicating that greater cognitive anxiety was associated with lower RAS/2-3Set scores and lower basic reading skill. The physiological anxiety subscale also correlated negatively and significantly with basic reading (\( r = -.200, p = .032 \)), indicating that greater physiological anxiety was associated with lower basic reading skill.

Depression and RAN/RAS

As shown in Table 5, the physiological depression subscale correlated negatively and significantly with both RAS/2-3Set subtest (\( r = -.203, p = .028 \)) and basic reading (\( r = -.354, p = .000 \)), indicating that greater physiological depression was associated with lower RAS/2-3Set scores and lower basic reading skill.

Hierarchical Regressions

Table 6 presents results from the hierarchical regression analysis including RAN-Object/Color RAN subtest as the dependent variable. Results showed that variables entered
Affective Contributions to Rapid Automatized Naming

into Step 1 collectively accounted for 12% of the variance of RAN-Object/Color. Among the variables entered in Step 1, significant Beta values were observed for processing speed only ($\beta = .349, p < .01$). The PAI cognitive subscales of anxiety and depression, affective subscales of anxiety and depression, and physiological subscales of anxiety and depression, entered as the variables in Step 2, accounted for 7.4% of the variance in RAN. This change in $R^2$ was not statistically significant ($p = .33$).

Table 7 presents results from the hierarchical regression analysis including RAN-Number/Letter subtest as the dependent variable. Results showed that variables entered into Step 1 collectively accounted for 4.7% of the variance of RAN-Number/Letter. Among the variables entered in Step 1, no significant Beta values were observed. The PAI cognitive subscales of anxiety and depression, affective subscales of anxiety and depression, and physiological subscales of anxiety and depression, entered as the variables in Step 2, accounted for 11.7% of the variance in RAN. This change in $R^2$ was not statistically significant ($p = .110$).

Table 8 presents results from the hierarchical regression analysis including RAS/2-3Set subtest as the dependent variable. Results showed that variables entered into Step 1 collectively accounted for 6.2% of the variance of RAS/2-3 Set. Among the variables entered in Step 1, no significant Beta values were observed. The PAI cognitive subscales of anxiety and depression, affective subscales of anxiety and depression, and physiological subscales of anxiety and depression, entered as the variables in Step 2, accounted for 16.8% of the variance in RAN. This change in $R^2$ was statistically significant ($p = .016$) and was associated with a partial correlation between cognitive anxiety and RAS/2-3Set, and cognitive depression and RAS/2-3Set ($r = -.270, r = .292$; after controlling for processing speed and basic reading skills).
Discussion

The present study examined whether affective variables predict unique variance in RAN above and beyond general processing speed and basic reading skills among individuals referred for clinical evaluation of learning difficulties. The present study, therefore, examined the reading-emotion association with affective processing as the independent variable and reading performance as the dependent variable. Results showed that affective variables predict significant variance in the RAS/2-3 Set subtest only. This finding is particularly notable because the RAS/2-3Set test is unique from other RAN subtests in that the RAN/2-3 Set includes an executive functioning component (e.g., mental set shifting). These findings suggest that executive functioning plays a central role in linking affective processing with reading.

Our study provides valuable information on the relationship between affective difficulties and reading skills. Past research strictly examined individuals with learning difficulties and disabilities and their perceived predisposal to affective disorders. Our study is also unique because it examined whether individuals with affective difficulties are predisposed to learning difficulties. Consistent with our hypothesis, affective predictors did predict unique variance in RAN scores above and beyond processing speed and basic reading skills. Our findings suggest that individuals who display certain affective predictors indeed display poorer scores on RAN; however, this relationship is not universal across all RAN subtests.

Reading-emotion association

Research suggests that individuals with learning disabilities are often predisposed to affective problems (Gray et al., 1983; McKenzie et al., 2000; Whittington & Alexander, 2001; Arthur, 2003), but less is known on whether affective problems worsen learning difficulties. Available studies have shown that lack of affective regulation hinders the use of higher-order
Affective Contributions to Rapid Automatized Naming

cognitive functions (i.e., working memory and attention) that are essential for learning and reading (Ladd, Birch, & Buhs, 1999; Ladd & Burgess, 2001). In addition, affective problems such as anxiety and depression often cause lapses in concentration or lack of effort, making engaging in the learning process difficult (Arthur, 2003). Accordingly, we proposed that the reading-emotion association is bidirectional, meaning individuals with affective problems may be at increased risk of developing learning difficulties. Specifically, we predicted that affective variables (i.e., anxiety and depression) would predict unique variance in RAN/RAS subtests.

Affective variables indeed predicted significant variance, but only in the RAS/2-3 Set subtest. The RAS/2-3 Set subtest is distinctively different from other RAN tests in that executive functioning is required. These findings suggest that the added component of executive functioning is what permits reading to overlap with emotion. Of the six affective variables, only cognitive anxiety and physiological depression correlated with RAS/2-3Set. Individuals who displayed high levels of cognitive anxiety or physiological depression subsequently displayed poorer RAS/2-3Set scores. The exact role of emotion in the reading process is unclear, however our results suggest that affective problems worsen performance on reading tasks that require executive functioning.

These findings are central for future intervention and assessment protocols. When individuals present symptoms of cognitive type anxiety or physiological type depression, it might be valuable to screen for learning difficulties, utilizing clinical measures of both reading and executive functioning. Likewise, when clients present with difficulty in executive functioning, it will be beneficial to screen for anxiety or depression as contributing factors. Current affective disorder interventions do not include any modules for learning remediation. While not all people with affective difficulties display learning difficulties, it is important to
screen for such difficulties and be ready to create treatment plans specific to the individual’s deficits.

**Limitations**

There are several limitations to this study. First, we did not include information on participant’s socioeconomic status (SES) or on previous interventions. This information is necessary to confirm that our sample is representative of the population. In addition, knowledge of past intervention might help to explain why some individuals with diagnosable affective disorders perform better than others or do not perform as poorly as expected.

Additionally, basic reading skill was used a control variable to account for participant differences in reading skill. However, because basic reading was only significantly correlated with the RAS/2-3Set subtest, this confound was not accounted for in either RAN subtest. We suspect this correlation to be due to the added executive functioning component of the RAS/2-3Set subtest. Perhaps using a different reading aptitude task that correlates with all RAN subtests would better account for individual differences. Moreover, most of our sample was composed of adults. While our sample allowed us to explore the reading-emotion relationship, using a sample of children might help to better determine the predictive power of affect on reading and the learning difficulties children might develop because of affective problems.

**Conclusions and future directions**

Results from the present study suggest that affective variables indeed predict unique variance in RAN above and beyond basic reading skill and processing speed. While affective variables did not predict significant variance in all RAN/RAS subtests, they did predict variance in the RAS/2-3Set subtest. We propose that the added executive functioning component in RAS/2-3Set plays a distinct role in the reading-emotion association. Cognitive
Affective Contributions to Rapid Automatized Naming

anxiety and cognitive depression significantly correlated with RAS/2-3Set, indicating that those affective predictors in specific predict impairment in RAS. Present results broadly suggest that affective processing may exert its effect “bidirectionally’ onto reading when executive functioning is employed.

To more accurately describe this relationship, further research is needed to examine external factors such as SES and presence of parents with affective disorders. Children of parents with affective disorders are significantly more prone to delayed psychomotor development (Harjan, 1989) and therefore might experience learning difficulties at greater rates. In addition, there is a greater prevalence of depression and school problems among children of depressed parents (Weissman et al., 1987). Our results suggest that affect intersects with reading when executive functioning is required. Our study explored the impact of affect on reading in general, however future studies need to explore affect and executive functioning specifically. Such research may have practical value given that affective disorder remediation seldom focuses on learning improvement strategies. If future research continues to demonstrate this bidirectional relationship, then learning remediation may need to be included in affective disorder interventions.
Affective Contributions to Rapid Automatized Naming

References


Affective Contributions to Rapid Automatized Naming


Affective Contributions to Rapid Automatized Naming

Table 1. Interpretation of High Scores on anxiety (ANX) Subscales (PAI: Morey, 1991)

<table>
<thead>
<tr>
<th>Subscale (Abbreviation)</th>
<th>Description of High Scores</th>
<th>Sample Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive (ANX-C)</td>
<td>These individuals report prominent worry and concern about current issues; these worries are present to the degree that the ability to concentrate and attend are significantly compromised. Their acquaintances are likely to comment about their overconcern regarding issues and events over which they have no control.</td>
<td>I often have trouble concentrating because I’m nervous. I’m often so worried and nervous that I can barely stand it.</td>
</tr>
<tr>
<td>Affective (ANX-A)</td>
<td>These individuals report experiencing a great deal of tension, difficulty in relaxing, and the presence of fatigue as a result of high perceived stress.</td>
<td>I am so tense in certain situations that I have great difficulty getting by. I can’t do some things well because of nervousness.</td>
</tr>
<tr>
<td>Physiological (ANX-P)</td>
<td>These individuals tend to experience and express stress in somatic form. They are likely to manifest overt physical signs of tension and stress, such as sweaty palms, trembling hands, complaints of irregular heartbeats, and shortness of breath.</td>
<td>I worry so much that at times I feel like I am going to faint. Sometimes I feel dizzy when I’ve been under a lot of pressure.</td>
</tr>
</tbody>
</table>
## Table 2. Interpretation of High Scores on depression (DEP) Subscales (PAI: Morey, 1991)

<table>
<thead>
<tr>
<th>Subscale (Abbreviation)</th>
<th>Description of High Scores</th>
<th>Sample Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive (DEP-C)</td>
<td>These individuals report thoughts of worthlessness, hopelessness, and personal failure. Indecisiveness and difficulties in concentration are also likely.</td>
<td>I feel that I’ve let everyone down. I can’t seem to concentrate well.</td>
</tr>
<tr>
<td>Affective (DEP-A)</td>
<td>These individuals report sadness, a loss of interest in normal activities, and a loss of pleasure in things that were previously enjoyed.</td>
<td>Much of the time I’m sad for no reason. I’ve forgotten what it is like to feel happy.</td>
</tr>
<tr>
<td>Physiological (DEP-P)</td>
<td>These individuals tend to experience and express depression in somatic form. They are likely to report a change in level of physical functioning, activity, and energy. They are likely to show a disturbance in sleep pattern, a decrease in level of sexual interest, and a loss of appetite and/or weight loss.</td>
<td>I hardly have any energy. I often wake up early in the morning and can’t get back to sleep.</td>
</tr>
</tbody>
</table>
## Affective Contributions to Rapid Automatized Naming

Table 3. Means, standard deviations, and skewness ($N = 88$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RAN-Object/Color</td>
<td>103.358</td>
<td>16.241</td>
<td>-.356</td>
</tr>
<tr>
<td>2. RAN-Number/Letter</td>
<td>106.977</td>
<td>9.435</td>
<td>-1.64</td>
</tr>
<tr>
<td>3. RAS/2-3Set</td>
<td>106.818</td>
<td>13.029</td>
<td>-.760</td>
</tr>
<tr>
<td>4. Processing Speed</td>
<td>97.761</td>
<td>14.530</td>
<td>.608</td>
</tr>
<tr>
<td>5. Basic Reading Skills</td>
<td>94.818</td>
<td>11.432</td>
<td>-.920</td>
</tr>
<tr>
<td>6. ANX-C-t</td>
<td>58.375</td>
<td>12.237</td>
<td>.443</td>
</tr>
<tr>
<td>8. ANX-P-t</td>
<td>59.182</td>
<td>12.687</td>
<td>.758</td>
</tr>
<tr>
<td>9. DEP-C-t</td>
<td>62.193</td>
<td>13.498</td>
<td>.490</td>
</tr>
<tr>
<td>11. DEP-P-t</td>
<td>56.080</td>
<td>9.406</td>
<td>-.216</td>
</tr>
</tbody>
</table>

Affective Contributions to Rapid Automatized Naming

Table 4. Pearson correlations (N = 88)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RAS/2-3Set</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Processing Speed</td>
<td>.200*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Basic Reading Skills</td>
<td>.214*</td>
<td>.238*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ANX-C</td>
<td>-.199*</td>
<td>-.133</td>
<td>-.201*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5. ANX-P</td>
<td>-.102</td>
<td>-.104</td>
<td>-.200*</td>
<td>.637**</td>
<td>-</td>
</tr>
</tbody>
</table>


* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$
Affective Contributions to Rapid Automatized Naming

Table 5. Pearson correlations (N = 88)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. RAS/2-3Set</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Processing Speed</td>
<td>.200*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Basic Reading Skills</td>
<td>.214*</td>
<td>.238*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. DEP-C</td>
<td>.115</td>
<td>-.129</td>
<td>-.094</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>10. DEP-P</td>
<td>-.203*</td>
<td>-.108</td>
<td>-.354***</td>
<td>.551***</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note. DEP = depression. Processing Speed is a subtest from the Woodcock-Johnson Tests of Cognitive Abilities III (Woodcock, McGrew, & Mather, 2001a). Basic Reading Skills is a subtest from the Woodcock-Johnson Tests of Achievement III (Woodcock, McGrew, & Mather, 2001b). Depression is a subscale from the PAI (Morey, 1991). RAS/2-3Set is a subtest of Rapid Automatized Naming (Wolf, Denckla, 2005).

* p ≤ .05
** p ≤ .01
*** p ≤ .001
Table 6. Regression results predicting RAN-Object/Color achievement (*N* = 88)

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Step 1</th>
<th></th>
<th></th>
<th>Step 2</th>
<th></th>
<th></th>
<th>95% Confidence Interval (Step 2)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td>Lower bound</td>
<td>Upper bound</td>
</tr>
<tr>
<td>Constant</td>
<td>69.43</td>
<td>15.01</td>
<td></td>
<td>87.62</td>
<td>21.80</td>
<td></td>
<td>44.22</td>
<td>131.02</td>
<td></td>
</tr>
<tr>
<td>Processing Speed</td>
<td>.37</td>
<td>.11</td>
<td>.35*</td>
<td>.36</td>
<td>.12</td>
<td>.35*</td>
<td>.14</td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>Basic Reading Skills</td>
<td>-.01</td>
<td>.14</td>
<td>-.01</td>
<td>-.12</td>
<td>.15</td>
<td>-.09</td>
<td>-.41</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>ANX-C-t</td>
<td>-2.27</td>
<td>.20</td>
<td>-.22</td>
<td></td>
<td></td>
<td></td>
<td>-.67</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>ANX-A-t</td>
<td>.17</td>
<td>.21</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td>-.24</td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>ANX-P-t</td>
<td>-.17</td>
<td>.19</td>
<td>-.14</td>
<td></td>
<td></td>
<td></td>
<td>-.55</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>DEP-C-t</td>
<td>.33</td>
<td>.18</td>
<td>.29</td>
<td></td>
<td></td>
<td></td>
<td>-.03</td>
<td>.68</td>
<td></td>
</tr>
<tr>
<td>DEP-A-t</td>
<td>.03</td>
<td>.19</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td>-.36</td>
<td>.41</td>
<td></td>
</tr>
<tr>
<td>DEP-P-t</td>
<td>-.26</td>
<td>.23</td>
<td>-.16</td>
<td></td>
<td></td>
<td></td>
<td>-.72</td>
<td>.21</td>
<td></td>
</tr>
</tbody>
</table>

\[ Δ F\text{-score} (df1, df2) \]
\[ Δ R^2 \]
\[ F\text{-score} (df1, df2) \]
\[ R^2 \]
\[ \text{Adjusted } R^2 \]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.18</td>
<td>(6,77)</td>
</tr>
<tr>
<td></td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.67(2,83)**</td>
<td>2.32(8,77)*</td>
</tr>
<tr>
<td></td>
<td>.12</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>.10</td>
<td>.11</td>
</tr>
</tbody>
</table>

*Note: ANX = anxiety; DEP = depression. Processing Speed is a subtest from the Woodcock-Johnson Tests of Cognitive Abilities III (Woodcock, McGrew, & Mather, 2001a). Basic Reading Skills is a subtest from the Woodcock-Johnson Tests of Achievement III (Woodcock, McGrew, & Mather, 2001b). Anxiety and Depression are subscales from the PAI (Morey, 1991).*

*a Squared semi-partial correlation

* *p < .05

** *p < .01
Affective Contributions to Rapid Automatized Naming

Table 7. Regression results predicting RAN-Number/Letter achievement ($N = 88$)

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Step 1</th>
<th></th>
<th>Step 2</th>
<th></th>
<th>95% Confidence Interval (Step 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Constant</td>
<td>93.42</td>
<td>7.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing Speed</td>
<td>.10</td>
<td>.06</td>
<td>.19</td>
<td>.10</td>
<td>.06</td>
</tr>
<tr>
<td>Basic Reading Skills</td>
<td>.05</td>
<td>.07</td>
<td>.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANX-C-t</td>
<td></td>
<td></td>
<td>-.20</td>
<td>.10</td>
<td>-.32</td>
</tr>
<tr>
<td>ANX-A-t</td>
<td>.16</td>
<td>.11</td>
<td>.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANX-P-t</td>
<td>-.03</td>
<td>.10</td>
<td>-.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEP-C-t</td>
<td>.21</td>
<td>.09</td>
<td>.36*</td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>DEP-A-t</td>
<td>-.02</td>
<td>.10</td>
<td>-.03</td>
<td></td>
<td>-.21</td>
</tr>
<tr>
<td>DEP-P-t</td>
<td>-.22</td>
<td>.12</td>
<td>-.28</td>
<td></td>
<td>-.46</td>
</tr>
<tr>
<td>Δ F-score (df1, df2)</td>
<td></td>
<td></td>
<td>1.80(6,77)</td>
<td></td>
<td>.12</td>
</tr>
<tr>
<td>Δ R²</td>
<td></td>
<td></td>
<td>2.05(2,83)</td>
<td>1.89(8,77)</td>
<td></td>
</tr>
<tr>
<td>F-score (df1, df2)</td>
<td></td>
<td></td>
<td>.05</td>
<td></td>
<td>.16</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.05</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td>.08</td>
</tr>
</tbody>
</table>


* Squared semi-partial correlation

* $p < .05$

** $p < .01$
Table 8. Regression results predicting RAN/2-3Set achievement \((N = 88)\)

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Step 1</th>
<th></th>
<th></th>
<th>Step 2</th>
<th></th>
<th></th>
<th>95% Confidence Interval (Step 2)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>(\beta)</td>
<td>B</td>
<td>SE</td>
<td>(\beta)</td>
<td>Lower bound</td>
<td>Upper bound</td>
</tr>
<tr>
<td>Constant</td>
<td>80.19</td>
<td>11.93</td>
<td></td>
<td>100.34</td>
<td>16.41</td>
<td></td>
<td>67.67</td>
<td>133.01</td>
</tr>
<tr>
<td>Processing Speed</td>
<td>.13</td>
<td>.09</td>
<td>.16</td>
<td>.13</td>
<td>.09</td>
<td>.16</td>
<td>-.04</td>
<td>.30</td>
</tr>
<tr>
<td>Basic Reading Skills</td>
<td>.15</td>
<td>.11</td>
<td>.15</td>
<td>.04</td>
<td>.11</td>
<td>.04</td>
<td>-.19</td>
<td>.26</td>
</tr>
<tr>
<td>ANX-C-t</td>
<td></td>
<td></td>
<td></td>
<td>-.41</td>
<td>.15</td>
<td>-.44*</td>
<td>-.71</td>
<td>-.11</td>
</tr>
<tr>
<td>ANX-A-t</td>
<td></td>
<td></td>
<td></td>
<td>.19</td>
<td>.16</td>
<td>.20</td>
<td>-.13</td>
<td>.50</td>
</tr>
<tr>
<td>ANX-P-t</td>
<td></td>
<td></td>
<td></td>
<td>-.01</td>
<td>.14</td>
<td>-.02</td>
<td>-.30</td>
<td>.27</td>
</tr>
<tr>
<td>DEP-C-t</td>
<td></td>
<td></td>
<td></td>
<td>.39</td>
<td>.13</td>
<td>.45*</td>
<td>.12</td>
<td>.65</td>
</tr>
<tr>
<td>DEP-A-t</td>
<td></td>
<td></td>
<td></td>
<td>.00</td>
<td>.15</td>
<td>.00</td>
<td>-.28</td>
<td>.29</td>
</tr>
<tr>
<td>DEP-P-t</td>
<td></td>
<td></td>
<td></td>
<td>-.34</td>
<td>.18</td>
<td>-.28</td>
<td>-.69</td>
<td>.01</td>
</tr>
</tbody>
</table>

\(\Delta F\)-score \((df_1, df_2)\)
\[2.80(6,77)^*\]

\(\Delta R^2\)
\[.17^*\]

\(F\)-score \((df_1, df_2)\)
\[2.74(2,83)\]

\(R^2\)
\[.06\]

Adjusted \(R^2\)
\[.04\]

\(R^2\)
\[.23\]

\(\Delta R^2\)
\[.15\]


\(^a\) Squared semi-partial correlation

\(^* p < .05\)

\(^** p < .01\)