Rorschach Performance Assessment System (R-PAS) and vulnerability to stress: A preliminary study on electrodermal activity during stress

ABSTRACT

This study investigated the predictive validity of the ten Rorschach Performance Assessment System (R-PAS) variables from the Stress and Distress domain, by testing whether they predicted increased sympathetic reactivity to a mild, laboratory-induced stress, occurred one week after Rorschach administration. A relatively small student sample (N = 52) contributed to this research: During a first meeting (T1) participants were administered the Rorschach task according to R-PAS guidelines; about one week later (T2) their electrodermal activity (EDA) was recorded during exposure to a mild laboratory stress-inducing task. Based on literature indicating that exposure to stress tends to increase physiological vulnerability/reactivity to stressful situations, we anticipated that Stress and Distress R-PAS variables measured at T1 would positively correlate with increased sympathetic reactivity to stress at T2, as indicated by greater EDA changes from baseline to stress and recovery. Results partially confirmed our hypotheses: The (a) the mean of and (b) the majority of the Stress and Distress R-PAS variables were significantly correlated, in the expected direction, with *medium* and *medium* to *large* effect sizes.

Keywords: Rorschach; R-PAS; Stress; Skin Conductance; Electrodermal Activity.

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1. Introduction

Recently, a new Rorschach method aimed at enhancing the utility and psychometric foundation of Rorschach-based assessment was introduced. Named Rorschach Performance Assessment System (R-PAS; Meyer et al., 2011), its goal is to carry on and extend the efforts of the Comprehensive System (CS; Exner, 2003) to link Rorschach inferences to their evidence-base. Compared to CS, R-PAS has introduced some important, technical modifications (for details, see Meyer, 2011; and Meyer and Eblin, 2012). First, R-PAS administration includes procedures aimed at constraining the number of responses per protocol (R), so as to improve the psychometric efficiency of the test and reduce the number of overly short, poorly informative records (see Reese et al., 2014). Second, some CS variables are not included in R-PAS, others are included but with some variations (e.g., Viglione et al., 2014; Viglione, et al., 2011), and a few other variables that were not part of CS are included in R-PAS (e.g., Graceffo et al., 2014). The choice of which variables to select for R-PAS was largely affected by findings emerged from a series of systematic reviews and meta-analyses recently published in *Psychological Bulletin* (Mihura et al., 2013; see also Wood et al., 2015, and Mihura et al., 2015). Third, differently from CS, R-PAS draws on internationally-based (rather than U.S.) normative reference data, consistent with emerging research indicating that standard CS norms notably differ from many nonclinical samples from all over the world (Giromini et al., 2014; Meyer, et al., 2007; Meyer et al., 2014; Meyer et al., 2015; Viglione and Giromini, 2016; Viglione and Meyer, 2008). Based on these international norms, R-PAS raw scores may be converted into easy-to-use, standardized and normalized, standard scores (SS), which have a median of 100 and

standard deviation of 15. SS are derived from percentile transformation rather than scores means and standards deviations. This technique was adopted to place all variables on the same metric despite the uneven skew across the interpreted variable.

Because R-PAS was introduced recently in 2011, additional research on its validity and reliability would be beneficial. To contribute to this field of literature, the current study investigated the predictive validity of a subset of R-PAS scores. Specifically, we focused on R-PAS variables included in the Stress and Distress domain, one of the interpretive categories for R-PAS. We tested whether they are related to increased sympathetic arousal both during and soon after a laboratory, stress-inducing task.

1.1. Stress and Distress R-PAS Variables

R-PAS variables in the Stress and Distress domain are: inanimate movement (m); diffuse shading (Y); morbid content (MOR); Suicide Concern Composite (SC-Comp); Potentially Problematic Determinants (PPD); sum shading (YTVC'); Color-Shading Blend (CBlend); achromatic color (C'); Vista (V); and Critical Content divided by the number of responses (CritCont%). They are deemed to measure different aspects of the psychological functioning that relate, in various forms, to stress and distress. Below we briefly review them one at a time, based on the information reported in the R-PAS manual (Meyer et al., 2011). It should be pointed out that the negative or activating aspects of the interpretations are emphasized here as they are more relevant to this research.

Inanimate movement (m) is coded when the respondent sees inanimate objects in the act of moving, such as "clouds moving away" or "fireworks exploding in the air." This response is thought to reflect experiences associated with forces and activity outside of one's control and also indicative of distracting ideation. Hence, it is interpreted as an index of internal tension or

stress. Empirical data indicate that m correlates with experienced trauma, but not with self-reported anxiety.

Diffuse shading (Y) is coded when the respondent uses the shading of the inkblot to produce his or her response. Because this behavior reflects sensitiveness and attention to the tonal subtleties of the inkblot, when it occurs persistently across the responses it may reveal anxious vulnerability. Though additional studies on this topic are needed, some research data indicate that Y may in fact reflect a state of helplessness or uncontrollable stress.

Morbid content (MOR) is coded when the response includes some direct or indirect reference to death, damage and/or dysphoria. Multiple evidence relates MOR to depression, distress, trauma and related phenomena. Broadly stated, MOR associates with negative or damaged self-representations and depressive or negative attributions to the world.

The Suicide Concern Composite (SC-Comp) is a dimensional score that incorporates and combines several Rorschach variables presumably associated with suicidal ideation, risk or intentionality. Some research data indicate that its earlier, dichotomous version (i.e., the CS Suicide Constellation) predicts near-lethal suicidal acts and associates with serotonin turnover.

The variable Potentially Problematic Determinants (PPD) is generated by summing the values of a number of Rorschach scores theoretically associated with experiencing disturbing or stressful demands. Because the codes that make up PPD are considered to be psychologically taxing, this variable may be interpreted as an index of general, experienced, stressful stimulation.

The variable Sum shading (YTVC') is a score that becomes elevated when the respondent repetitively uses the shaded or achromatic features of the ink to generate his or her responses. Because this behavior likely reflects a marked sensitivity to dark, murky, mixed,

inconsistent, or indefinite features of the perceptual stimulus, YTVC' is thought to reveal implicit distress or an unsettled state.

Color-Shading Blend (CBlend) is coded when the respondent uses both the color and the shading of the ink to provide his or her response. Attending to colorful stimulations presumably reflects an attentiveness to emotionally loaded, vibrant or compelling stimuli. Conversely, attending to shading and/or dark or achromatic colors is typically considered as indicative of implicit distress. Accordingly, the CBlend variable is usually interpreted as an index emotional sensitivity.

Achromatic color (C') is coded when a response incorporates white, gray, or black features. Because it implies an attitude toward attending to or paying particular attention to dark or non-colorful stimuli, C' is thought to associated with depression and deadened emotional reactivity.

Vista (V) is coded when a three-dimensional effect is created by using some shaded features of the inkblot. This involves a sensitivity to the inconsistencies or contradictions in the stimulus and a stepping back or distancing visual process. Cognitively this involves some sophistication, but in a more negative context, V is thought to be associated with self-criticism or a painful or dysphoric affect, as supported by some empirical data.

Finally, Critical Content divided by the number of responses (CritCont%) is a variable that measures the presence of crude or disturbing themes in a Rorschach protocol, for example explosions, blood, damage, or aggression. It is typically interpreted as an index of the presence of such disruptive thoughts in consciousness and severity of psychopathology, and it is also associated with a history of trauma.

1.2. Stress, Sympathetic Reactivity to Stress, and Electrodermal Activity

Broadly stated, stress may be defined as a perturbation (either real or just perceived) to a person's psychological well-being or physiological homeostasis, and distress may be conceived of as a condition in which one's adaptive response or reaction to stress does not succeed at reestablishing homeostasis (Carstens and Moberg 2000; Moberg 1987). From this perspective, environmental stressors are activating and motivating, and good coping entails a successful response that relieves perturbation. Research supports the conclusion that persistent exposure to acute or chronic stress may alter an individual's coping mechanisms and biological functions: when stress persists (e.g., because attempts to relief it fail or are ineffective), the person becomes gradually more and more vulnerable to various sources of stressors, which typically is manifested in an over-reactivity to mild stressors (Moberg, 2000). Essentially, the more a person is subjected to stress and distress and is not able to reduce it, the poorer his/her ability to cope with stress will tend to be.

Stressful situations typically trigger increased activity in the sympathetic nervous system (SNS). In response to a stressor, SNS activity increases to mobilize metabolic energy for fight-or-flight reaction (e.g., McEwen, 1998). In these situations, the adrenal glands release cortisol and other stress hormones, and the sympathetic-adrenomedullary axis releases catecholamines (mainly adrenaline and noradrenaline) to meet the increased metabolic demands posed by the stressor. Prolonged release of catecholamines, however, may induce serious consequences for both physical and mental health. In fact, high levels of stress hormones increase the risk for phenomena such as hypertension, insulin resistance, hypercholesterolemia, and hyperlipidemia (e.g., Brindley and Rolland, 1989, Rosmond et al., 1995), which in turn are primary risk factors for various life-threatening metabolic and cardiovascular conditions. High levels of stress hormones also tend to affect the activity of neurotransmitters important to brain structures such

as the amygdala and the hippocampus, increasing the likelihood to develop psychological problems such as anxiety, sleep disorders, or selective cognitive impairments (Arnsten, 1998; Lupien and Meaney 1998; De Kloet et al., 1998; McEwen et al., 1999; Nemeroff, 1996; Rosen and Schulkin, 1998). As such, individuals who are vulnerable to stress and distress are generally show exaggerated sympathetic reactions to stress (Meaney, 2001).

Among others, a commonly adopted method to measure SNS vulnerability and reactivity to stressful situations is to measure electrodermal activity (EDA) fluctuations (Porges, 1991). Indeed, because EDA depends on activity of sweat glands, and sweat glands are innervated by the SNS (and not by the parasympathetic nervous system), changes in skin conductance, or EDA levels are thought to reflect activity of the SNS. Therefore, greater EDA changes from a baseline to a stressful condition likely reflect greater vulnerability, or SNS reactivity, to day-by-day stressors. In line with this hypothesis, increased EDA changes from baseline to stress associates, for example, with self-reported anxiety (Weems et al., 2005) and internalizing symptoms (El-Sheikh, 2005).

1.3. The Current Study

Because exposure to stress and distress tends to increase physiological vulnerability and responsivity to stress, one may reasonably expect that R-PAS variables in the Stress and Distress domain would be associated with increased sympathetic reactivity to stress. Indeed, given that exposure to stress and distress associates with increased vulnerability to stress, the levels of stress and distress detected by the Rorschach inkblot method should correlate with the respondent's degree of sympathetic reactivity during a stressful situation or challenging task.

The current study investigated this hypothesis by conducting a simple experiment with a relatively small student sample (N = 52). During a first meeting (T1) participants were

administered the Rorschach task according to R-PAS guidelines; about one week later (T2) their EDA was recorded during exposure to a mild laboratory stress-inducing task, involving a three-phase baseline-stress-recovery trial. Because EDA changes from baseline to stress are supposed to index sympathetic activity and vulnerability (Papez, 1937; Christie, 1973; Boucsein, 1992; Ionescu-Tirgovişte and Pruna, 1993; Kozarić-Kovacić et al., 2010; Mestanik et al., 2014), we hypothesized that Stress and Distress R-PAS variables measured at T1 would positively correlate with increased EDA changes from baseline to stress at T2 (i.e., with increased sympathetic reactivity to stress). Additionally, assuming that EDA changes from baseline to recovery reflect prolonged sympathetic arousal following stress, we also tested correlations between Stress and Distress R-PAS variables and EDA changes from baseline to recovery.

2. Method

2.1. Participants and Procedures

The present article reports on EDA and Rorschach data from 52 psychology students (42 women) ranging in age from 18 to 25 (M = 20.8; SD = 1.5). All participants were recruited at University of Turin (Italy), during psychology classes, after the bio-ethical committee of the institution had formally approved the research project. Participants had never been administered the Rorschach, and in line with commonly adopted procedures for studies on SNS functioning, inclusion and exclusion criteria required that participants were not currently undertaking psychiatric medications, did not have history of psychiatric disorders or neurological illness, were not currently affected by psychological disorders, were non-smokers, and were not engaged in professional sport activities. All participants (as well as examiners) were native Italian speaking.

Participants were seen on three occasions. Initially, prospective participants were met in a quiet room to ensure inclusion and exclusion criteria, and to obtain written consent. During this preliminary meeting, some baseline psychophysiological data (e.g., heart rate, skin conductance, etc.) were collected to check for potential physiological anomalies, to inspect test-retest reliability of our physiological measure (i.e., EDA), and to let participants familiarize with our EDA recording procedures. At this step, one prospective participant was excluded from the study because of an extremely elevated EDA signal, which the participant revealed to be due to her being affected by hyperhidrosis, a medical condition in which individuals sweat excessively and unpredictably (Maillard and Lecouflet, 2015). Importantly, this step also allowed participants to become familiar with our electrophysiological recording procedures, so that at T2 (see below) their baseline EDA would not be affected by reactions to the experimental, recording situation (which would obviously affect also skin conductance differences between baseline, stress and recovery conditions).

About one week later, individuals included in the study were administered the Rorschach task, R-PAS method (T1). Four examiners contributed to Rorschach data collection: All were advanced psychology students (i.e., research assistants) who had previously attended and passed a college-level Rorschach course, and who had been in Rorschach training with the first or second author for several months. The first and second authors, who are expert Rorschach users, carefully supervised data collection and coding of all protocols.

About one week after T1, the same participants were exposed to a standard three-phase, baseline-stress-recovery experimental paradigm while their EDA was recorded (T2). Specifically, during *baseline*, they were asked to rest quietly for 12 minutes (during the first 6 minutes they were asked to relax while standing up, during the last 6 minutes they were asked to

relax while sitting). Immediately after this resting period, a 6 minutes stress-inducing task was initiated (*stress*). This task involved performance of serial subtraction, i.e., the Mental Arithmetic Task (Dickerson and Kemeny, 2004) accompanied by discouraging feedback (sometimes called 'harassment') from the experimenter (e.g., 'Stop a second – remember to go as fast as you possibly can. Okay, keep going'). This method of inducing stress and anxiety has been widely used in previous social psychophysiological studies (for example Condren et al., 2002; Earle et al., 1999; Kirschbaum et al., 1995; Lai and Linden, 1992), and debriefing after the experiment revealed that none of the participants could tell that these interruptions were staged, and all were feeling angry, frustrated, and/or stressed. The physiological data provide further, objective support for effectiveness of the stress intervention: As shown in Figure 1, statistically significant EDA changes occurred from baseline to stress, $p < .01$. The procedure ended with a 6 minute recovery period (*recovery*), in which participants were asked again to rest quietly. Although EDA did decrease from stress to recovery, EDA at recovery still was significantly higher than at baseline, $p < .01$, thus indicating that some sympathetic arousal persisted also after the stressful stimulation, during recovery (see Figure 1). Noteworthy, the association between skin conductance level at rest during our preliminary meeting and skin conductance level at T2 baseline, i.e., about two weeks later, consisted of an intraclass correlation coefficient (ICC) of .84, which is indicative of excellent test-retest stability, thus leaning support to the high reliability our target, electrophysiological measure (for benchmarks to interpret ICC values, see Cicchetti, 1994; and Shrout and Fliess, 1979). Upon completion of the recovery phase, participants were thanked for their participation, and debriefed that the interruptions (i.e., discouraging feedback) during the Mental Arithmetic Task were staged.

2.2. Measures

2.2.1. Rorschach Variables and Inter-rater Reliability

As indicated above, the current study focused on variables located in the Stress and Distress interpretative domain of R-PAS. Specifically, we investigated the following variables: inanimate movement (m); diffuse shading (Y); morbid content (MOR); Suicide Concern Composite (SC-Comp); Potentially Problematic Determinants (PPD); sum shading (YTVC'); Color-Shading Blend (CBlend); achromatic color (C'); Vista (V); and Critical Content divided by the number of responses (CritCont%).

To assess inter-rater reliability, the first author, who is an expert R-PAS user who serves as reviewer for the official "R-PAS proficiency" certification exam (see www.r-pas.org), randomly selected and independently recoded 15 of the available protocols whose collection and scoring were previously supervised by the second author. For the variables included in the current study, intraclass correlation coefficients (ICCs) ranged from 0.77 (MOR) to 0.96 (PPD), thus indicating excellent inter-rater reliability (for benchmarks on how to interpret ICCs, see Cicchetti, 1994; and Shrout and Fliess, 1979).

2.2.2. Electrodermal Activity (EDA) Measurement

Since temperature and humidity can influence EDA (Boucsein, 1992), all participants were welcomed in temperature and humidity controlled rooms (~18-22°C; humidity not higher than 50%). Along the same lines, because EDA may be affected by Circadian rhythms too (Venables & Mitchell, 1996), experimental sessions were held during the same time (9.30 am – 1.30 pm) in the same season.

Upon arrival, each participant was invited to seat in an armchair with comfortable headrest, arms, and back. After following standard, skin-cleaning procedures (Fowles et al., 1981; Schmidt and Walach, 2000), EDA was measured by applying Ag-AgCl electrodes on the

distal (first) phalanges of the index and middle fingers of the participants' dominant hand. Electrical signal, more in detail, was recorded on line using Psycholab VD13S system (Satem, Rome, Italy) interfaced to a portable computer via Ethernet cable and with Psycholab P.C. Software (Operating system-Windows XP). It was acquired in micro-Siemens (μS) at a sampling rate of 100 Hz, via constant voltage method (0.5 V). To detect and remove artifacts and noise peaks, data were filtered and pre-processed off line by using STAPIK.

Because our goal was to examine sympathetic reactivity and vulnerability to stress, our statistical analyses focused on the EDA changes from baseline to stress and recovery. More specifically, the increment of the average EDA during stress over the average EDA during baseline was labeled "EDA Change: Stress minus Baseline," and was used as proxy marker for sympathetic reaction to stress. The increment of the average EDA during recovery over the average EDA during baseline was labeled "EDA Change: Recovery minus Baseline," and was used as proxy marker for prolonged, sympathetic arousal following stressful stimulation. This procedure follows previous EDA studies with baseline, stress, and/or recovery conditions (Healey and Picard, 2005; El-Sheikh et al. 2007; Reinhardt et al., 2012).

2.2.3. Data Analysis

Prior to analyzing the data, we checked for outliers, anomalous data, missing values, artifacts, and other potential sources of error. As noted above, we also tested the reliability of our target measures. In fact, both the inter-rater reliability of the selected Rorschach variables and the test-retest stability of our EDA measurement were found to be excellent, according to standard benchmarks.

The main hypothesis of the study was that Stress and Distress R-PAS variables would predict sympathetic reactivity to stress. To investigate this hypothesis, a correlation matrix

investigating the association of Stress and Distress R-PAS variables to “EDA Change: Stress minus Baseline” and “EDA Change: Recovery minus Baseline” was generated.

3. Results

In table 1, we summarize descriptive statistics of R-PAS variables in the Stress and Distress domain. As one may easily notice, none of the Rorschach variables had skew greater than 2.0 or kurtosis greater than 7.0, so that no mathematical steps to deal with non-normality issues were deemed necessary (for details, see Curran et al., 1996). In addition, no outliers were detected. Conversely, one of the EDA variables under investigation initially presented one extreme outlier value. Specifically, one of the subjects had an “EDA Change: Stress minus Baseline” value of 23.2 μS, which was more than three standard deviations above the mean of the sample. Accordingly, this variable was Winsorized, and its outlier value was set to one unit above the second-highest value of the variable, i.e., it was set to 16.0. It should be noted, however, that post-hoc analyses revealed that regardless of whether we used the original, non-transformed EDA change variable, or its Winsorized version, results would lead to exactly the same conclusions in terms of significance testing, with virtually identical effect sizes. Descriptive statistics for all EDA measures under investigation are reported in Table 2.

Despite the sample size being relatively small ($N = 52$), which obviously limits statistical power, the mean of all Stress and Distress variables correlated .30 ($p = .03$) with sympathetic reactivity to stress (i.e., “EDA Change: Stress minus Baseline”), and .40 ($p < .01$) with continued sympathetic activation during recovery (i.e., “EDA Change: Recovery minus Baseline”). Nine of the 20 tested correlations were significant at $p < .05$ and 19 were the expected, positive direction.

In more detail, three Rorschach variables, i.e., MOR, CBlend, and V, significantly correlated with “EDA Change: Stress minus Baseline”, and six correlated with “EDA Change:

Recovery minus Baseline." Three additional results (YTVC' with EDA Change: Stress minus Baseline, and C' and CritCont% with EDA Change: Recovery minus Baseline) would be statistically significant at a less conservative alpha value of .10. On the other hand, none would remain statistically significant at a Bonferroni-corrected alpha level of $p = .0025$ (i.e., .05 / 20).

We next conducted multiple regression analyses to test whether the R-PAS codes that produced significant correlations with our criterion variables would make unique contributions to their prediction. Specifically, MOR, CBlend, and V were entered as predictors in a first, stepwise regression model with "EDA Change: Stress minus Baseline" as criterion variable; MOR, SC-Comp, PPD, YTVC', CBlend, and V were next entered as predictors in a second, stepwise regression model with "EDA Change: Recovery minus Baseline" as criterion variable. Interestingly, both these analyses generated a very similar model, in which V and MOR were the two best predictors. In fact, the first of these models (i.e., the one with "EDA Change: Stress minus Baseline" as criterion variable) was statistically significant $F(2, 49) = 8.69$, $p \leq 0.01$, and accounted for about 25% of the criterion variance, $R = 0.51$, $R^2 = 0.26$, *Adjusted* $R^2 = 0.23$, with both MOR, $\beta = 0.38$, $p < 0.01$, and V, $\beta = 0.35$, $p < 0.01$, uniquely contributing to the prediction. The second of these models (i.e., the one with "EDA Change: Recovery minus Baseline" as criterion variable) also was statistically significant $F(2, 49) = 8.61$, $p \leq 0.01$, also accounted for about 25% of the criterion variance, $R = 0.51$, $R^2 = 0.26$, *Adjusted* $R^2 = 0.23$, and also had MOR, $\beta = 0.38$, $p < 0.01$, and V, $\beta = 0.35$, $p < 0.01$, uniquely contributing to the prediction. Taken together, these findings indicate that MOR and V were the best predictors of both sympathetic reactivity to stress, and continued sympathetic arousal after stress, during recovery.

As an example, Figure 2 graphically shows the association with EDA reactions to stress produced by two composite variables obtained either by averaging the SS of all Stress and

Distress R-PAS variables, or by averaging the SS of MOR and V only. All in all, these graphical representations contribute to showing that the observed relationships between the selected R-PAS variables and the EDA reactions to stress are unlikely to be the result of measurement artifacts or outliers.

4. Discussion

The current study investigated whether ten Stress and Distress R-PAS variables associated with increased sympathetic reactivity and vulnerability to stress, as one would expect given that exposure to stress and distress typically enhances physiological responsivity to stress. With a relatively small student sample (N = 52), we analyzed electrodermal activity (EDA) in response to a mild laboratory stress-inducing task and tested whether EDA responses (i.e., EDA differences from baseline to stress and recovery) could be predicted by R-PAS variables in the Stress and Distress domain. In line with our hypotheses, several Stress and Distress R-PAS variables were significantly associated with increased EDA responses to stress, and 19 of the 20 tested correlations were in the expected direction. In particular, MOR and V were the best predictors of sympathetic reactivity to stress, and continued sympathetic arousal during recovery.

The fact that MOR significantly associated with our criterion variables with a *medium* or *medium* to *large* effect size (Cohen, 1988) is not surprising. According to Mihura et al. (2013), the MOR is one of the most valid variables within the Stress and Distress domain, and Exner (2003) designed the score as a measure of depression. Furthermore, the response process behind the production of MOR's is largely in line with its traditional interpretation. Indeed, MOR's are deemed to reflect morbid, pessimistic, and/or damaged ideation processes, and are therefore believed to indicate that the respondent might view himself/herself as a distressed person, who is flawed or harmed by life. The results of our study support the traditional interpretation of

MOR's, as more distressed individuals are more likely to show increased reactivity or vulnerability to stress.

V also significantly correlated with our criterion variable, with a *medium* or *medium* to *large* effect size. Typically, this variable is interpreted as index of implicit distress, as it reflects a marked sensitivity to the diffuse, mixed, dark and/or indefinite nuances of the inkblot, and it involves taking perspective or distance. Though V has demonstrated enough empirical support so that it is part of R-PAS, currently there is some debate as to whether it actually reflects a maladaptive behavior, as in fact shading tends to positively correlate with development (Giromini et al., 2014; Meyer et al., 2007; Stanfill et al., 2013). Given the observed association between V and sympathetic reactivity to stress, our findings do support the hypothesis that it may index implicit distress and vulnerability to stress.

Interestingly, when MOR and V were entered together in multiple regression analyses, our criterion variables were predicted with multiple-*R*'s of 0.5, and both the Rorschach scores uniquely contributed to their prediction. Based on these findings, future research might further test whether combining the scores of these two variables would offer any advantages over using each variable individually. Indeed, because these codes address relatively different aspects associated with stress – MOR reflects morbid content and reveals damaged or dysphoric visual imagery, while V is a determinant score and indicates attention to tonal subtleties or dark nuances associated with dimensionality and/or perspective taking – a composite score integrating the scores of MOR and V might be particularly sensitive to measure vulnerability to stress. Future research might further investigate these speculations.

Somewhat surprisingly, some stress and distress variables failed to produce significant correlations with the criterion. In some cases, this unexpected finding might be due to our sample

size being relatively small so that we did not have enough power to detect *medium* to *small* effect sizes. This might be particularly true for variables such as C' or CritCont%, which in fact produced *r* values close to or greater than .2 in the expected direction, albeit not significantly so. However, such an explanation would not apply to variables such as inanimate movement (m) or diffuse shading (Y), which yielded much smaller effect sizes with Pearson *r* values approaching zero. Accordingly, future studies should further investigate whether these variables may or may not associate with psychological constructs close to that of vulnerability to stress.

Our study has a number of limitations that deserve mentioning. The most evident limit of our study is the small sample size, which did not allow to detect *medium-small* effect sizes. Indeed, with our limited power, none of the correlations remained significant after applying a conservative, Bonferroni-corrected alpha level of .0025. Thus, because type 1 and type 2 errors are possible with our multiple analyses, our findings are to be considered as preliminary, and should be replicated and explored with other criteria and large samples. Additionally, the sample only comprised students, which also limits the generalizability of the findings. The relatively homogeneity of the sample also might have contributed to produce a floor effect, given that it is unlikely that our participants actually had severe vulnerability to stress. Another important limitation of this study is that because our experiment used a laboratory stress-inducing task, the ecological validity of our research may be questioned. Lastly, it should be noted that EDA responses may be attenuated by conditions such as depression or autonomic diabetes neuropathy: although our inclusion/exclusion criteria required the participants to be mentally and physically healthy, we cannot rule out that our data still were affected by some uncontrolled, similar factors.

Despite these (and other) shortcomings, our study still has the merit to be the first to report data on the predictive validity of the stress and distress R-PAS variables by using

physiological data. In particular, it is noteworthy that despite all the limitations listed above, some of the Rorschach scores taken into consideration were in fact able to predict the physiological response to stress a participant would have had about a week later.

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Table 1. Descriptive Statistics of R-PAS Variables in the Stress and Distress Domain (N = 52).

	M	*SD*	*Skew*	*Kurtosis*
m	101.8	13.6	0.7	0.8
Y	109.5	15.5	0.0	-1.0
MOR	102.9	12.8	0.1	-1.0
SC-Comp	104.9	14.8	-1.0	1.1
PPD	109.4	16.6	0.1	-0.9
YTVC’	112.3	14.5	0.2	-0.8
CBlend	104.0	13.9	0.8	-0.1
C’	112.7	14.1	0.1	-0.2
V	107.9	15.0	0.5	-0.7
CritCont%	95.3	16.0	0.5	0.0

Table 2. Electrodermal Activity (EDA) during Baseline, Stress, and Recovery: Descriptive Statistics (N = 52)

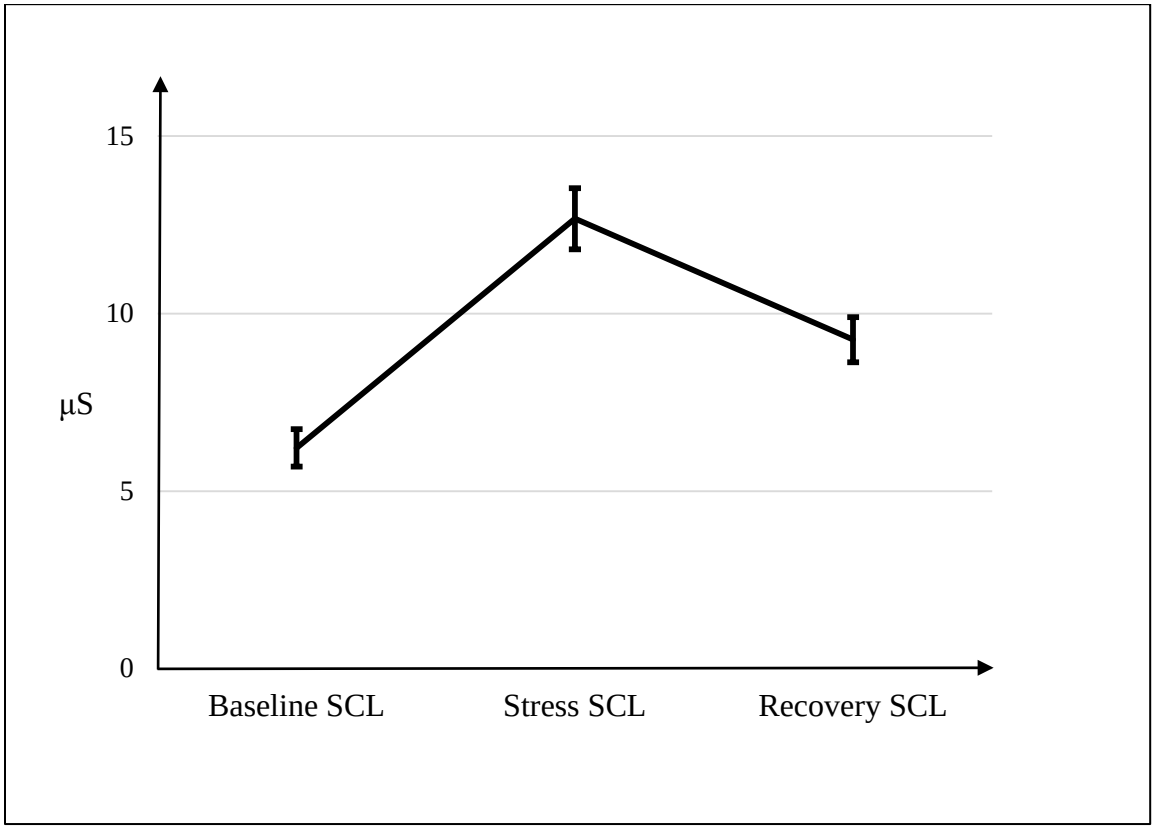
	M	*SD*	*Skew*	*Kurtosis*
Skin Conductance Level during Baseline (μS)	6.2	3.8	0.9	0.7
Skin Conductance Level during Stress (μS)	12.7	6.2	0.7	0.2
Skin Conductance Level during Recovery (μS)	9.3	4.6	0.6	0.0
EDA Change: Stress minus Baseline (μS)	6.5	4.4	0.8	0.1
EDA Change: Recovery minus Baseline (μS)	3.1	2.5	0.7	-0.4

Table 3. Correlations of Stress and Distress R-PAS Variables to Electrodermal Activity (EDA) Changes from Baseline to Stress and Recovery

	EDA Change: Stress minus Baseline	EDA Change: Recovery minus Baseline
m	-0.08	0.04
Y	0.01	0.11
MOR	0.37**	0.34*
SC-Comp	0.23	0.36**
PPD	0.16	0.29*
YTVC’	0.23(*)	0.32*
CBlend	0.31*	0.32*
C’	0.19	0.25(*)
V	0.35*	0.37**
CritCont%	0.22	0.26(*)

** $p < 0.01$; * $p < 0.05$; (*) $p < 0.10$.

Figure 1. Average Skin Conductance Level (SCL) during Baseline, Stress, and Recovery (*N* = 52)



Notes. SCL differences between baseline, stress, and recovery were significantly different, $F(2, 102) = 99.69$, $p < .001$, *Partial* $\eta^2 = .66$. All Bonferroni corrected pairwise comparisons were significant at $p < .001$. Error bars represent the standard error of the mean.

Figure 2. Relationship of Rorschach Averaged Variables to EDA Changes from Baseline to Stress and Recovery (N = 52)