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Evaluative Conditioning and Neuroticism: Investigating the Evaluative Responses to a Composed Ambivalent Stimulus

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Individuals high in neuroticism often display a negativity bias, giving more weight to negative information. This bias may contribute to the onset and maintenance of emotional disorders. Ambivalence, the co-occurrence of positivity and negativity within the same stimulus or context, seems to highlight the presence of negativity bias associated with neuroticism. Recently, previous research revealed such a bias by creating ambivalent conditioning scenarios using Evaluative Conditioning. In our experiment, we conceptualized ambivalence within one composed ambivalent stimulus. The stimulus is compounded by one CS (i.e., conditioned stimulus) conditioned with a positive US (i.e., unconditioned stimulus) and one CS conditioned with a negative US during an EC procedure. Thus, we aimed that the composed ambivalent stimulus would receive negative evaluations from participants high on neuroticism. We conducted pre- and post-test evaluations to assess the change in likeability scores, revealing significant differences in evaluations based on the CS-US pairings. Our results confirm the EC effect, indicating that the likeability of CSs was aligned with the valence of the US. While our hypothesis was not confirmed, a positive correlation emerged between worry levels and positive evaluations of the ambivalent stimulus. Supplementary analyses reinforced these findings, revealing no significant associations between personality variables and the evaluations of the main CSs. Our experiment did not emphasize the negativity bias associated with neuroticism in an ambivalent conditioning scenario. Still, it revealed some other intriguing results that invite us to reflect on the various methodologies used to investigate the relation between personality and EC.

Keywords: Evaluative Conditioning, Neuroticism, Ambivalence, Negativity Bias.

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Introduction

Neuroticism represents a primary personality trait of the Five-Factor Model (FFM; Costa & McCrae, 1992), generally defined by negative emotionality, emotional instability, and maladjustment. People with higher levels of neuroticism are prone to exhibiting negative emotions more frequently (Barlow et al., 2014; Eysenck, 1947). They also experience intense negative emotions (the meta-analysis of Kalokerinos et al., 2020) and significant everyday variability in them (Mader et al., 2023). Some authors also call this trait negative emotionality (e.g., Lilienfeld, 2020; Tellegen, 1985). Besides the emotional part, people who score high on neuroticism generally perceive the world as a dangerous place, respond negatively to stress and the unknown, and exhibit overwhelming helplessness in coping with challenging situations (e.g., Goldberg, 1993; Hirsh et al., 2012).

The trait neuroticism has amassed a great deal of attention due to its relation with psychopathology, being considered a predisposing factor for developing and maintaining emotional disorders such as anxiety and depression (Ormel et al., 2013; the meta-analysis of Kotov et al., 2010; Vittengl, 2017). This tendency seems to be emphasized by the negativity bias (i.e., the primacy given to processing negative information rather than positive one; Chan et al., 2007), another specific characteristic related to neuroticism. According to the Vulnerability Model (Ormel et al., 2013), neuroticism seems to be an increased risk factor for the onset of psychopathology or the enhancement of the impact of other related-risk factors (e.g., stressful life events) due to the prospective activation of cognitive (and affective) biases. Thus, people scoring high on neuroticism report negativity biases at the attentional level. For instance, they pay more attention to negative and less to positive information (e.g., Rijsdijk et al., 2009). At the memory level, people who score high on neuroticism seem to recognize and recall negative events and information better (e.g., Gomez et al., 2002). All these negativity biases exhibited by people who report high levels of neuroticism might represent distortions about (negative) past events, being potential triggers for depression and anxiety (e.g., Norris et al., 2019).

Beyond the established relationship between neuroticism and negativity biases, an important question arises: in which contexts do individuals high on neuroticism exhibit negativity biases (that potentially contribute to the development and maintenance of common mental disorders)? Empirical evidence suggests that ambiguous situations are the most vulnerable contexts for individuals with high neuroticism to exhibit negativity bias, which predisposes them to develop affective disorders such as social anxiety and depression (e.g., Sauer-Zavala & Barlow, 2021). For instance, people who score high on neuroticism interpret ambiguous information negatively (e.g., Salemink & van den Hout, 2010). Looking at the behavioral component, they mostly avoid ambiguous stimuli, perceiving them as aversive (Lommen et al., 2010). Hirsh and Inzlicht (2008) found that uncertain feedback, compared to negative feedback, produced a larger neural response in people who scored high on neuroticism, resulting in more intense affective responses. Individuals with higher neuroticism scores also manifest discomfort with ambiguity, exhibiting intolerance to it (e.g., Jach & Smillie, 2019; Lauriola et al., 2016).

In addition to the relation between neuroticism and ambiguity, which emphasizes the presence of uncertainty or the lack of clarity in a particular situation (Carson et al., 2006), ambivalence is also associated with neuroticism, contributing in the same way as ambiguity. Most definitions of ambivalence underline opposite feelings or attitudes toward a given situation, object, or person. The core characteristics of ambivalence emphasize the simultaneous experience of positivity and negativity, which is, at least theoretically, highly conflictual, uncomfortable, and arousing (e.g., Cacioppo et al., 1997, 1999; Norris et al., 2010).

Research on neuroticism and ambivalence proves a consistent link between them, particularly in emotion regulation and interpersonal relationships. For instance, Kokkonen and Pulkkinen (2001) conducted a longitudinal study investigating how personality traits influence emotion regulation over time. Their findings emphasize that higher levels of neuroticism at age 27 predicted greater emotional ambivalence and a reduced use of adaptive emotion regulation strategies by age 36. This indicates that individuals with high neuroticism might encounter emotional ambivalence because of difficulties in handling conflicting emotions. Pinquart et al. (2008) underline the role of neuroticism in experiencing ambivalence by feeling conflicting emotions during life decisions. Their results revealed that people who score high on neuroticism tend to express greater ambivalence regarding parenthood. Miller and Pilkonis (2006) also revealed that people high on neuroticism are prone to experience interpersonal ambivalence by showing more conflicting emotions in their relationships.

Recently, a new research direction on neuroticism and its association with negativity biases emerged in the merged fields of neuroticism and preference learning. Evaluative Conditioning (EC) is a learning preference paradigm that consists of pairing a neutral or novel stimulus (conditioned stimulus; CS) with a positive or negative stimulus (unconditioned stimulus; US), resulting in a change in evaluative response (or preference) of the CS due to the CS-US pairing (De Houwer, 2007; see Moran et al., 2023, for a review). The results of Vogel et al. (2019) revealed a significant relationship between neuroticism and the EC effect. The authors found that CSs paired with negative USs were evaluated more negatively as the neuroticism scores increased in the study's population. However, participants who scored high on neuroticism evaluated the CSs paired with positive USs as more positive. Hence, people with high levels of neuroticism seem to present stronger EC effects regardless of the US valence (positive or negative). Casini et al. (2023) also identified significant results on neuroticism and the EC effect. They further introduced the evaluations of the USs as mediators of EC in their analyses. The results revealed that people high on neuroticism evaluated the USs as more extreme on their valences, leading, in turn, to extreme evaluations of the CSs that they were paired with. However, Ingendahl and Vogel (2023) found a weak moderation effect of neuroticism on the EC effect. Moreover, the USs' evaluations did not mediate the relation between neuroticism and the EC effect in this study.

Most of the studies on neuroticism and EC involved a straightforward pairing method, which is supposed to pair CSs with positive or negative USs. However, many real-life situations are not completely clear or predictable, even if we speak about the learning of preferences. Nevertheless, ambiguous or ambivalent elements introduced in the EC procedure might generate unpredictable responses from one participant to another, eliciting individual differences in their (evaluative) responses (Snyder & Ickes, 1985).

In a recent paper, Bunghez et al. (2023) implemented unpredictable EC conditions. To investigate the relationship between neuroticism and emotional learning during positivity-negativity co-occurrence (i.e., ambivalence), the authors created ambivalent EC conditions using ambivalent USs (i.e., two positive and negative pictures combined within the same image) paired with CSs (Experiment 1). In Experiment 2, Bunghez et al. (2023) manipulated the CS-US contingencies to generate ambivalence. They produced positivity-negativity co-occurrence (i.e., ambivalence) by alternatingly pairing the CSs with positive and negative USs. Besides these ambivalent conditions, both experiments involved three other conditions: (1) a positive EC condition, in which the CSs were always paired with positive USs; (2) a negative EC condition, in which the CSs were always paired with negative USs; and (3) a neutral EC condition, in which the CSs were always paired with neutral USs. The results of both experiments revealed that the CSs from the ambivalent EC conditions received more negative evaluations at higher neuroticism scores (compared to the neutral conditions). The authors pointed out that such ambivalent EC contexts, where positivity and negativity co-occur, may reflect vulnerable situations in which individuals with high neuroticism display their learned negativity biases. Additionally, the results showed that the participants who scored higher on neuroticism (and anxiety) generally gave more negative ratings to the CSs, even if they were paired with only positive, negative, or neutral USs.

The current experiment further investigated the relationship between neuroticism (and other related measurements such as the behavioral inhibition system (BIS) and the worry component of anxiety) and the potential negativity bias expressed in an EC procedure with an ambivalent stimulus. Based on the literature, we consider the co-occurrence of positivity and negativity as one of the most informative conditions regarding how much weight people who score high on neuroticism give to the negative aspects.

Hence, the EC procedure would be simple, involving a CS paired with a positive US and a CS paired with a negative US. However, the evaluative stage would suppose evaluative responses of preferences for those two CSs and a compound ambivalent stimulus composed of the two CSs

presented during the EC. The composed ambivalent stimulus would not be explicitly presented during the EC procedure. It would be constructed by overlapping the two main CSs. As Bunghez et al. (2023) operationalized ambivalence conditioning by pairing CSs with ambivalent USs in Experiment 1 and by pairing CSs alternatively with both positive and negative USs, the novelty of the current experiment consists in capturing the negativity bias associated with neuroticism in a context of experiencing simultaneous (learned) positivity and negativity, capturing the ambivalence at the same time, accordingly to its definition (e.g., Cacioppo et al., 1997, 1999; Norris et al., 2010). This condition was achieved by exposing participants to a composed ambivalent stimulus created by overlapping a positively conditioned CS with a negatively conditioned CS. That is, in our experiment, ambivalence is generated by overlapping two CSs—one previously paired with only a positive US and the other with only a negative US. Therefore, compared to Bunghez et al. (2023), the co-occurrence of (learned) positivity and negativity (i.e., ambivalence) within the composed CS results from the initial positive and negative conditioning of each CS that forms the final ambivalent CS.

As a real-world analogy, imagine that one would receive positive feedback on a presentation and negative feedback on another presentation. Finally, that person would have to work with information from both presentations. Given the mixed feedback, a new task involving simultaneously positivity and negativity, that individual might experience ambivalence. We predicted that in such an ambivalent context, individuals with high neuroticism would provide more negative evaluations, due to their tendency to predominantly develop negative attitudes in ambivalent preference situations (e.g., Bunghez et al., 2023). In addition to neuroticism, we examined the role of the Behavioral Inhibition System (BIS) and the worry component of anxiety, considering some relevant results reported by Bunghez et al. (2023) as potential moderators of the relationship between ambivalent conditions and exhibited negativity bias.

Methods

Design

The conditioning procedure involved a 2-level (USs' valence: Positive vs. Negative) within-subjects unifactorial design.

Participants

This experiment initially involved 141 Romanian students. All participants received extra credit for taking part in this study. A total of 26 participants were excluded based on the following two criteria: responding incorrectly to the control item at the end of the personality questions section ("If you are paying attention to this item, choose option three.") and responding incorrectly to the questions that required recognizing to what US each of the two main CSs was paired with during the EC procedure (i.e., valence awareness; Stahl et al., 2009).

The final sample included 115 participants (Mage = 25.43, SD = 8.59). The gender distribution involved 74 females, 36 males, 3 participants who did not want to specify their gender, and 2 participants who responded with "Other."

Materials

For this experiment, all the materials were provided in English. Thus, in the current study, we used three personality questionnaires. The 12-item Negative Emotionality Scale from the Big Five Inventory-2 (BFI-2; Soto & John, 2017) was used as a neuroticism measurement. This trait was measured on a 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree). We also calculated the scores for the facets (i.e., Anxiety, Depression, and Emotional Volatility). The internal consistency indexes (Cronbach's) for the trait and its facets were: Negative Emotionality (α = .91), Anxiety (α = .80), Depression (α = .84), and Emotional Volatility (α = .85). A short version of the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990), which includes five items, was used to measure the level of worry exhibited by adults. The responses were recorded on a 5-point Likert scale from 1= Not at all typical of me to 5 = Very typical of me. The Cronbach's α for this scale is .91. Behavioral Inhibition System (BIS), from the BIS/BAS instrument (Carver & White, 1994), was measured using a 7-item scale. The responses were also recorded in a Likert format from 1 (Strong disagreement) to 4 (Strong agreement). The Cronbach's α for the BIS scale is .78.

The EC procedure involved, as USs, two pictures from the International Affective Picture System (IAPS; Lang et al., 2008). The picture coded as 2035, which shows a little girl laughing, was used as the positive US, and the picture coded as 2345.1, which shows a little boy with a black eye, was used as the negative US. These stimuli were previously used in EC experiments in our lab, demonstrating their conditioning power. As CSs, we used two images that represent geometrical figures. One image shows a red circle, while another shows two green squares. A supplementary image that combines these two CSs represents the composed ambivalent stimulus, which was presented only during the evaluation stage. Figure 1 shows the visual representations of these three stimuli.

Procedure

The materials used in the current experiment were provided via Inquisit 6 software (2016). Immediately after launching the program, the consent form appeared on the screen. Participants who agreed with the presented consent had to click the "Next" button. Demographic data were collected after participants' consent (e.g., age, gender). Following this part, we required a short evaluation of the two main CSs and the composed ambivalent stimulus regarding likeability ("To what extent do you like this image?"). Each of the three images was presented on the screen separately and randomly to one participant after another. The responses were recorded on a scale ranging from -3 (*Very unpleasant*) to 3 (*Very pleasant*). This evaluation was used to verify how much participants liked or disliked the CSs and the composed stimulus before the conditioning procedure. The responses given during this evaluation also represent a way to further control for the neutrality of these stimuli when analyzing data. The evaluation was necessary given the type of CSs (i.e., geometrical figures) we had not previously used in our studies. Next, the personality questionnaires were provided. First, participants filled in the 12-item Negative Emotionality from BFI-2 (Soto & John, 2017), followed by the short version of PSWQ (Meyer et al., 1990), and BIS (Carver & White, 1994). Immediately after BIS, a control item was provided ("If you are paying attention to this item, choose option three.") to detect participants who did not pay attention to the personality items. Then, the EC procedure started and included only the two main CSs (i.e., the red circle and the two green squares). Each of the two CSs was simultaneously presented on the screen with the same US

during this procedure. When a CS was paired with the positive US, the other CS was paired with the negative US. The CS was always shown on the left side of the screen, while the US was on the right. The CS-US pairings were counterbalanced across participants to control for the effect of the same pairings. Also, the pairings were shown randomly on the screen. Each pair was presented eight times, resulting in 16 trials. The exposure time was 3000 ms with an inter-trial interval of 1000 ms. Following the EC procedure, the likeability was again measured using the same question as in the pre-test. Each of the three stimuli, the two main CSs from the EC procedure and the composed ambivalent stimulus, was shown randomly on the screen. The evaluative responses were given on the same scale from -3 (*Very unpleasant*) to 3 (*Very pleasant*). Finally, valence awareness (VA; Stahl et al., 2009) was measured by asking: "With what kind of photography was this image paired with, during the first task?". Again, each of the three images was presented randomly on the screen. Participants had to pick one of the following answers: 1 – *Pleasant photos*, 2 – *Unpleasant photos*, 3 - *Both pleasant and unpleasant photos*, 4 - *Neither pleasant nor unpleasant photos*, or 5 - *I do not remember*. In the end, the participants were thanked for their participation, receiving extra credit for a course in the field of psychology.

Sample Size Determination

We targeted the current experiment as a pilot study using the composed ambivalent stimulus. Thus, we aimed to collect a sample size of around 150 participants to ensure a statistical power of .80 to detect a correlation of .20 / -.20 with a p-value of .05.

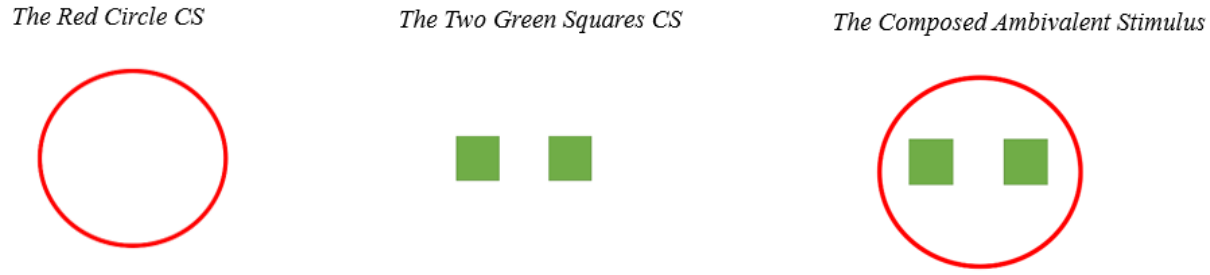

Figure 1. The Red Circle CS, The Two Green Squares CS, and The Composed Ambivalent Stimulus

Results

This experiment's data and R code are available on the OSF. They can be accessed at the following link: https://osf.io/hdvaf/?view_only=b18a32c7bccd4dd290bac90685349fc5. In Appendix A, we presented the descriptive statistics for the personality variables (see Table 1 from Appendix A), and the descriptive statistics for the evaluations of the stimuli when including the pre-test scores of CSs (see Table 2 from Appendix A) and when excluding the pre-test scores of CSs (see Table 3 from Appendix A).

As we mentioned, we introduced into the analyses data from the participants who paid attention to the control item in the final personality questionnaire and were aware of what US the two main CSs were paired with during the EC procedure (i.e., 100% positive VA for the CS paired with the positive US and 100% VA for the CS paired with the negative US). Given its lack of conditioning, we did not consider participants' responses to the composed ambivalent stimulus.

Considering the pre-test likeability evaluations of all three stimuli, we analyzed the data while controlling for their neutrality. We computed the difference for each valence category by subtracting the pre-test likeability score from the post-test likeability score (Change Score = LikePost – LikePre).

Preliminary analyses

First, we checked whether the EC effect appeared. We identified a significant difference between the CS paired with the positive US ($M = 0.65$, $SD = 1.24$) and the CS paired with the negative US ($M = -1.11$, $SD = 1.47$): $t(114) = 8.66$, $p < .001$, $d = 0.80$ (the difference of the means is 1.76, 95% CI [1.36, 2.16]). As expected, both CSs were evaluated in the direction of the US's valence (positive or negative), with which they were paired.

Regarding the compound stimulus obtained by combining the two main CSs, namely the composed ambivalent stimulus, we expected that it would be evaluated more negatively compared to the CS paired with the positive US and more positively compared to the CS paired with the negative US. The results showed that, indeed, the composed ambivalent stimulus was evaluated more negatively ($M = -0.42$, $SD = 1.13$) compared to the CS paired with the positive US ($M = 0.65$, $SD = 1.24$): $t(114) = -7.07$, $p < .001$, $d = 0.66$ (the difference of the means is -1.07, 95% CI [-1.38, -0.77]). Also, the composed ambivalent stimulus was evaluated more positively ($M = -0.42$, $SD = 1.13$) compared to the CS paired with the negative US ($M = -1.11$, $SD = 1.47$): $t(114) = 4.58$, $p < .001$, $d = 0.42$ (the difference of the means is 0.68, 95% CI [0.38, 0.98]). Previous experiments on neuroticism and EC tested the EC effect using the likeability scores after the EC procedure only (e.g., Bunghez et al., 2023). We presented such results as supplementary ones. They are mentioned in Appendix B. The EC effect was also revealed when we used only the post-test likeability scores.

Main Analyses

According to our central hypothesis, we investigated the relationship between neuroticism (along with the anxiety-related measures) and the evaluative responses (i.e., likeability) received by the composed ambivalent stimulus after the conditioning procedure of both CSs that compose it. We introduced the change score into the analyses (LikePost – LikePre) for the likeability variable. Thus, when we controlled for the pre-test evaluations, we found no significant association between the ratings received by the composed ambivalent stimulus and neuroticism: $r = .14$, $p = .134$. Moreover, we found no significant association between the ratings the composed ambivalent stimulus

received and BIS: r = .08, p = .364. Surprisingly, the ratings for the composed ambivalent stimulus were positively linked to the level of worry shown by the participants: r = .21, p = .02, 95% CI [.03, .38], suggesting that the higher the level of worry, the more positively the composed ambivalent stimulus was evaluated. Interestingly, when we controlled for the pre-test, the correlations were positive, even if one was significantly positive (the relation between the level of worry and the ratings for the composed ambivalent stimulus). However, when we only looked at the post-test evaluations, the correlations between the composed ambivalent stimulus and personality-related variables were negative, even if they were statistically insignificant. Only the correlations between the CS paired with positive US and personality-related variables were significantly negative (see Table 1 below).

Table 1. *Correlations between the Personality Variables and the Post-Test Likeability Evaluations Only*

Personality Variables	CS paired with Positive US	CS paired with Negative US	The Composed Ambivalent Stimulus
Negative Emotionality (BFI-2)	-.22*	.08	-.08
Anxiety	-.16	.02	-.11
Depression	-.20*	.11	-.004
Emotional Volatility	-.22*	.09	-.10
PSWQ	-.18*	.03	-.06
BIS	-.02	-.02	-.17

Note. *Significant result at $p < .05$.

Supplementary Analyses

In addition to the main analyses, we investigated whether the data for this experiment validated the results of previous studies on EC and personality, particularly on neuroticism and other related variables (e.g., Bunghez et al., 2023). Using the change score to control for the pre-test evaluations, the results revealed that neither the CS paired with the positive US nor the CS paired with the negative US presented any association with neuroticism and its facets, BIS, or the level of worry exhibited by the participants (see Table 2 presented below).

However, when looking only at the correlations between personality-related variables and the pre-test scores, the composed ambivalent stimulus was negatively associated with each personality variable (see Table 3 below), suggesting that people high on neuroticism, BIS, and worry tend to give stronger dislike ratings to initially neutral stimuli or to perceive the composed stimulus as more unpleasant from the start (before conditioning the two CSs that composed it).

Table 2. *Correlations between the Personality Variables and Evaluations of the Two Main CSs when Controlling for the Pre-Test*

Personality Variables	CS paired with Positive US	CS paired with Negative US
Negative Emotionality (BFI-2)	-.08	.12
Anxiety	-.01	.10
Depression	-.09	.12
Emotional Volatility	-.11	.08
PSWQ	-.06	.14
BIS	-.02	.13

Table 3. *Correlations between the Personality Variables and the Pre-Test Likeability Evaluations Only*

Personality Variables	CS paired with Positive US	CS paired with Negative US	The Composed Ambivalent Stimulus
Negative Emotionality (BFI-2)	-.14	-.04	-.19*
Anxiety	-.15	-.09	-.19*
Depression	-.11	-.02	-.12
Emotional Volatility	-.10	.001	-.19*
PSWQ	-.12	-.12	-.23*
BIS	-.001	-.17	-.23*

Note. *Significant result at $p < .05$.

General Discussion

The current experiment investigated the relationship between neuroticism and evaluative responses to a composed ambivalent stimulus obtained by overlapping two conditioned stimuli (CSs) via Evaluative Conditioning (EC) (i.e., one CS paired with a positive US and one CS paired with a negative US). Besides the evaluations received by the two main CSs involved in the EC procedure, the stimulus resulting from the combination of those CSs (i.e., the composed ambivalent stimulus) was the central element of our hypothesis, supposing that the higher the neuroticism scores, the greater the negative evaluations towards the composed ambivalent stimulus. Considering various other intriguing results and possible explanations, the main prediction concerning our hypothesis was not supported by the data of the present experiment.

As the empirical evidence supports, ambiguous contexts seem to be one of the most vulnerable situations for people who score high on neuroticism, as they respond more negatively to them (e.g., Lommen et al., 2010; Salemink & van den Hout, 2010). Thus, people who score high on neuroticism are more prone to exhibit negativity bias in such conditions (e.g., Gomez et al., 2002; Rijsdijk et al., 2009). Recognizing the vulnerable contexts, such as the ambiguous ones, in which individuals with high neuroticism display negativity bias is crucial, due to the significant impact of negativity bias on the onset and maintenance of emotional disorders (e.g., Beck & Haigh, 2014; Sauer-Zavala & Barlow, 2021). In addition to ambiguity, which entails uncertainty or a lack of clarity (Carson et al., 2006), ambivalence also influences how much individuals (high on neuroticism) oscillate between the positive and negative aspects of a situation or decision, between pleasant and unpleasant experiences, and between approaching or avoiding a change (e.g., Miller and Pilkonis, 2006; Pinquart et al., 2008). That is, ambivalence emphasizes the co-occurrence of positivity and negativity, which seems to be highly conflictual, uncomfortable, and arousing (e.g., Cacioppo et al., 1997, 1999; Norris et al., 2010).

As far as we know, one paper has focused on the relationship between neuroticism and ambivalence conditioning created via EC (Bunghez et al., 2023). The cited authors created ambivalent conditioning scenarios by pairing CSs with ambivalent USs (Experiment 1) and by pairing CSs alternatingly with positive and negative USs (i.e., contingency manipulation; Experiment 2). In both experiments, the authors identified that people who scored high on neuroticism evaluated the CSs from the ambivalent scenarios as more negative (compared to the CSs from the neutral conditioning condition), emphasizing the negativity bias expressed by people high on neuroticism in contexts of positivity-negativity co-occurrence. Our experiment revealed the ambivalence (i.e., composed ambivalent stimulus) by overlapping two CSs paired with a positive US and a negative US, respectively, during a straightforward EC procedure. Contrary to the previous findings, in our experiment, neither neuroticism nor BIS correlated with the evaluations of the composed ambivalent stimulus. However, important differences between our experiment and those implemented by Bunghez et al. (2023) might be mentioned. First, there was a significant difference in how we operationalized the ambivalence. In Bunghez et al. (2023), the ambivalent conditions were constructed by pairing CSs with validated ambivalent USs (Experiment 1) or by alternatingly pairing CSs with positive and negative USs. In our experiment, the composed ambivalent stimulus was considered ambivalent because of the overlap between a positive conditioned geometrical figure and a negative conditioned geometrical figure. The ambivalence of the resulting stimulus may depend on how much participants transfer positive and negative valence onto each independent conditioned stimulus (CS). This transfer affected how participants perceived and evaluated the ambivalent stimulus, highlighting the interaction of positive and negative associations in shaping their overall response. Additionally, we used, as a dependent variable, the change score (post-test score minus pre-test score). Bunghez et al. (2023) only examined post-test evaluative responses. Since our pre-test evaluations of the ambivalent stimulus negatively correlated with personality, we note that the expected result related to our hypothesis might be biased. There are also other methodological differences in Bunghez et al. (2023), such as the neutral conditioning conditions used as reference points to emphasize the negativity bias seen in individuals high on neuroticism when evaluating the CSs from the ambivalent

conditioning, as well as the large sample size involved in providing evaluative responses, which introduces considerable variability in the data.

However, we found a positive association between the worry level and the composed ambivalent stimulus evaluations. Surprisingly, the result suggests that the higher the level of worry, the more positively the composed ambivalent stimulus was evaluated. As it is known, worry is a core component of anxiety, which presents sensitivity towards situations that are not entirely positive or negative (e.g., Hirsh et al., 2012). However, evidence suggests that individuals with high levels of anxiety, as a neuroticism facet, may focus on the positive side in an EC setting, reflecting a potential coping mechanism they use to lessen the perceived threats detected around them (see Casini et al., 2023). Another explanation might come from the stress induction perspective (e.g., Mathews & MacLeod, 1994), which supposes that (negativity) bias might appear after stress or other mood-related state induction. It is possible that the composed ambivalent stimulus does not trigger any ambivalence stress-related mood. As we presented in the Results section, our findings revealed that the significantly negative correlations between worry and the ratings received by the composed ambivalent stimulus at the pre-test evaluation proved that the composed ambivalent stimulus was evaluated more negatively when it was targeted as a novel or neutral stimulus (before the EC procedure). The positive association between the level of worry experienced by the participants and the positive evaluations they made of the composed ambivalent stimulus, after the two main CSs that compound the stimulus were conditioned, might suggest that the co-occurrence of positivity and negativity within the same stimulus made the composed ambivalent stimulus as a more pleasant one. As a result, participants who expressed higher levels of worry evaluated the composed ambivalent stimulus as more positive.

Additionally, we examined correlations between personality variables and the evaluations of the CS paired with the positive US and the CS paired with the negative US, respectively. Our study results indicated that neither the CS paired with the positive US nor the CS paired with the negative US showed any association with neuroticism and its facets, BIS, or the level of worry expressed by the participants. Therefore, our findings do not align with those presented by Vogel et al. (2019), who demonstrated that at higher levels of neuroticism (specifically the anxiety facet), participants rated the CSs paired with positive USs more pleasant and the CSs paired with negative USs more unpleasant. Our results also contrast with those that Bunghez et al. (2023) revealed, showing that participants with higher neuroticism scores evaluated the CSs from the straightforward conditions (positive, negative, and neutral) as more negative.

Thus, our results are neither congruent with the classical perspective on neuroticism that supposes that people high on neuroticism are more sensitive to negative stimuli (e.g., Eysenck, 1967; Gray, 1981) and, in turn, would transfer more negative valence to the CSs, nor congruent with the perspective of heightened focus on all valenced stimuli (positive and negative) expressed by people with elevated scores at neuroticism (e.g., Larsen & Diener, 1987).

In the analyses, we introduced the evaluative responses controlling for the pre-evaluative conditioning, as most of the studies did (e.g., Casini et al., 2023; Vogel et al., 2019), whereas Bunghez et al. (2023) worked only with post-evaluative conditioned evaluations. Interestingly, our data revealed significantly negative correlations between personality-related variables and the pre-test ratings for the composed ambivalent stimulus only. This result might suggest that our participants who reported high scores on neuroticism, BIS, and worry gave stronger dislike ratings to the initially neutral stimulus only (targeted by us as a composed ambivalent stimulus) or perceived the composed stimulus as more unpleasant from the start (before conditioning the two CSs that composed it) (compared to those CS geometrical figures which not received any significant evaluations in the pre-test). Therefore, since our pre-test evaluations of the ambivalent stimulus negatively correlated with personality (making it be evaluated negatively from the pre-test), we recognize that the expected result related to our hypothesis might be biased. Given the lack of replication, explaining why the targeted composed stimulus was negatively associated with personality from the start is difficult (compared with the lack of association between personality and each geometrical figure). However, we can infer that the complexity of the stimulus—compared to each CS presented independently in the pre-test evaluation—might require more cognitive resources for people with high levels of neuroticism, worry, etc, or even the novelty of it compared with a simpler (expected), one-geometrical figure stimulus.

Limitations and Future Directions

Recognizing the limitations inherent in this research is essential for appropriately contextualizing the results. First, we used a small number of CSs for each condition (i.e., one CS paired with a positive US and one with a negative US). Thus, the variability of the evaluative responses per condition might be reduced compared to the responses from other EC experiments and personality (e.g., Vogel et al., 2019). Second, the CSs were colored geometric figures that could hold specific meanings for each participant. Even though controlling for the pre-EC evaluations diminished this point, the CSs were not pre-tested in prior studies. Conversely, the USs were not evaluated by each participant. However, they were extracted from a standardized valenced picture system (i.e., IAPS) and were used in previous experiments (e.g., Bunghez et al., 2023). Furthermore, employing one US for each condition (i.e., positive and negative) may weaken the strength of valence transfer to each CS, which could negatively affect the likelihood of finding a significant correlation. Moreover, the USs used in the current experiment reflected human faces that expressed joy or sadness. Using human faces as USs may decrease the saliency of valence, reducing the chance of revealing a significant effect, as we expected. Regarding the sample, even if Romanian students formed the sample of our experiment, the experiment's instructions and materials were provided in English. Thus, the language might represent a weakness in the correctness of understanding, which interferes with addressing valid personality differences in negativity bias within ambivalent conditions. Furthermore, the absence of preregistration prevented prior assessment of the current experimental design, and the lack of replication prevented a definitive conclusion about the current findings.

Given the aforementioned limitations and the mixed results in the literature on neuroticism and EC (with

ambivalent conditions), further investigation of this topic is required. Firstly, suppose one agrees with implementing a methodology similar to the one used in the present study. In that case, we encourage introducing at least two composed ambivalent stimuli for checking if the results are the same as ours (people who report high levels of worry, neuroticism, and BIS generally evaluate ambivalent stimuli as more negative at the pre-test) or if the results vary as a representation of stimuli. Second, we recommend pre-testing any stimulus that is supposed to be included in an ambivalent conditioning scenario and keeping the neutral stimuli only in those conditions. Given the negative impact of ambivalence on emotion regulation, another direction would imply the investigation of emotion regulation strategies (beyond personality and anxiety variables) on evaluations of conditioned stimuli in positivity-negativity co-occurrence scenarios.

Conclusion

Understanding how neuroticism shapes emotional responses to ambivalence is vital, as it plays a significant role in fostering a negativity bias, which can adversely affect emotional health and contribute to the onset of emotional disorders. The present study sought to delve into the complex interplay between neuroticism and evaluative responses to a composed ambivalent stimulus, constructed through Evaluative Conditioning (EC). While prior research has consistently shown that those high in neuroticism respond more negatively to CSs from ambivalent conditions, our results revealed no significant link between neuroticism and the evaluations of the two main conditioned stimuli or with the composed ambivalent stimulus. Notably, we observed a significantly positive association between worry and the ratings received by the composed ambivalent stimulus. However, this result might be influenced by the significant negative correlation revealed at the pre-test. Thus, our experiment did not emphasize the negativity bias associated with neuroticism in an ambivalent conditioning scenario, but revealed some other intriguing results that invite us to reflect on the various methodologies used to investigate the relation between personality and EC.

Declaration of Interest Statement

The authors declare that there are no conflicts of interest with respect to the authorship of this paper.

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Appendix A

Table 1. *Descriptive Statistics for the Personality Variables*

Personality Variables	*M*	*SD*	*Skewness*	*Kurtosis*
Negative Emotionality (BFI-2)	31.93	10.58	-.051	-.768
Anxiety	12.93	3.95	-.150	-.754
Depression	10.35	4.10	.360	-.895
Emotional Volatility	11.64	4.11	-.017	-.737
PSWQ	15.73	5.59	-.164	-1.052
BIS	19.48	3.89	-.361	.064

Table 2. *Descriptive Statistics for the Evaluations of the Stimuli (Controlling for the Neutrality)*

Evaluations of the Stimuli	*M*	*SD*	*Skewness*	*Kurtosis*
CS paired with Positive US	0.65	1.24	-.251	2.712
CS paired with Negative US	-1.11	1.47	-.459	-.237
The Composed Ambivalent Stimulus	-0.42	1.13	-.559	.752

Note. The evaluations of the stimuli are represented by the change score on likeability calculated as a difference between the evaluations received by the stimuli after the EC procedure and the evaluations received by the stimuli at the pre-test (before the EC procedure): LikePost - LikePre.

Table 3. *Descriptive Statistics for the Evaluations of the Stimuli (Without Controlling for the Neutrality)*

Evaluations of the Stimuli	*M*	*SD*	*Skewness*	*Kurtosis*
CS paired with Positive US	1.02	1.21	-.685	1.052
CS paired with Negative US	-0.93	1.34	.370	-.260
The Composed Ambivalent Stimulus	-0.48	1.43	.424	.171

Note. The evaluations of the stimuli refer only to the evaluations received by the stimuli after the EC procedure.

Appendix B

Calculating the EC effect by using the likeability scores from the post-test only

When we look at evaluations received by the stimuli after the EC procedure only, we identify the same pattern of results regarding the EC effect. Thus, the CS paired with the positive US (M = 1.02, SD = 1.21) was evaluated more positively compared to the CS paired with the negative US (M = -0.93, SD = 1.34): $t(114) = 11.24$, $p < .001$, $d = 1.04$ (the difference of the means is 1.95, 95% CI [1.61, 2.30]).

Regarding the composed ambivalent stimulus, the results showed that it was evaluated more negatively (M = -0.48, SD = 1.43) compared to the CS paired with the positive US (M = 1.02, SD = 1.21): $t(114) = -10.34$, $p < .001$, $d = 0.96$ (the difference of the means is -1.51, 95% CI [-1.80, -1.22]). Also, the composed ambivalent stimulus was evaluated more positively (M = -0.48, SD = 1.43) compared to the CS paired with the negative US (M = -0.93, SD = 1.34): $t(114) = 3.26$, $p = .001$, d = 0.30 (the difference of the means is 0.44, 95% CI [0.17, 0.71]).

Appendix C

Calculating the differences in evaluative responses between the pre-test and post-test

The CS paired with positive US during the EC procedure was evaluated more positively at the post-test (M = 1.02, SD = 1.21) compared to the pre-test (M = .37, SD = 1.21): $t(114) = -5.62$, $p < .001$, 95% CI [-.88, -.62].

The CS paired with negative US during the EC procedure was evaluated more negatively at the post-test (M = -0.93, SD = 1.34) compared to the pre-test (M = .18, SD = 1.28): $t(114) = 8.10$, $p < .001$, 95% CI [.84, 1.38].

The composed ambivalent stimulus was evaluated more negatively at the post-test (M = -0.48, SD = 1.43) compared to the pre-test (M = -.06, SD = 1.45): $t(114) = 4.03$, $p < .001$, 95% CI [.21, .63].