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The psychometric properties of the Italian version of Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ)

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ABSTRACT

Reinforcement Sensitivity Theory (RST) conceptualizes personality as the long-term stability of brain process underlying motivational states. It proposes three systems: the Behavioral Approach System (BAS), the Behavioral Inhibition System (BIS), and the Fight-Flight-Freeze System (FFFS). The current study examined the psychometric properties of the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ) in an Italian community sample of 332 participants (62.7 % female), aged between 18 and 77 years. Results confirmed that the Italian version of the RST-PQ demonstrates strong psychometric properties in terms of both internal consistency and factor structure. Reliability analyses indicated that all scales exhibited good-to-excellent reliability, comparable to the values reported in the original validation study of the RST-PQ, as well as in other language adaptations. A series of confirmatory factor analyses support the six-factor structure of the Italian RST-PQ, yielding fit indices equal to or better than those of the original version. The Italian version of the RST-PQ shows promise as a useful tool for both research and clinical applications. In particular, its capacity to differentiate between the BIS and FFFS constructs provides valuable insights for investigating and understanding motivational tendencies, reactivity, and behavioral patterns in contexts characterized by distress and fear-related phenomena in an Italian population.

1. Introduction

From an evolutionary perspective, both the approach to positive stimuli and the avoidance of negative stimuli are conceptualized as fundamental motivational systems, that lead organisms toward or away from stimuli (e.g., Del Giudice, 2022; Elliot, 2006; McNaughton et al., 2016). Reinforcement Sensitivity Theory (RST; Gray, 1982; Gray & McNaughton, 2000; McNaughton, 2024) is widely recognized as one of the most comprehensive neurobiological frameworks for understanding individual differences and personality, grounded in approach-avoidance motivational systems.

The original thesis of RST was that personality emerges from activity and individual differences in three neurobehavioral systems: the Behavioral Approach System (BAS), the Fight-Flight System (FFS), and the Behavioral Inhibition System (BIS; Gray, 1982). These systems control learning patterns that arise from the interplay between environmental stimuli and motivational or emotional responses (Gray, 1982). In this latter case, RST emphasized the role of BAS and BIS as mediators of emotional and behavioral responses to environmental conditioned rewards (BAS) and punishments (BIS), whereas FFS responded to unconditioned threats. Later, in the revised version of the RST (Gray & McNaughton, 2000), the activity of the three systems was redefined and clarified, and they were related to each other in more detail. BAS was associated with the evaluation of rewarding stimuli, driving organisms toward reward-seeking behaviors, and fostering feelings of anticipation and enjoyment, while evolutionarily, BAS was selected for solving adaptive challenges related to resource acquisition. Behaviors driven by BAS are typically oriented toward reward pursuit and consumption (Craig, 1918) – although the BAS was not seen as being involved in the consumption component. In contrast, the FFS system has been extended to become the Fight-Flight-Freeze System (FFFS), as it is responsible for the evaluation of punishing stimuli and promotes the avoidance of dangerous or aversive situations. FFFS activates when a person perceives an imminent threat, triggering avoidance, freezing, or

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fighting responses, depending on the environmental contingencies, as well as perceived 'defensive distance'. When BAS and FFFS are simultaneously activated, motivational conflicts arise. These conflicts are resolved by the BIS, which induces states of uncertainty and promotes risk assessment and behavioral inhibition (e.g., Gray & McNaughton, 2000; McNaughton & Corr, 2014). In fact, BIS in the revised version of the RST helps maintain psychological balance by promoting *cautious* behavior and anxiety-related psychological states.

RST provides a significant contribution to understanding personality by defining motivations in functional and neurobiological terms, an approach particularly valuable in explanatory perspectives on personality (e.g., Del Giudice, 2022; Zeiger-Hill et al., 2019). RST defines personality as the long-term stability of the neural systems underlying motivational states, reflected in the activity of the BIS, BAS, and FFFS systems (Corr & Krupić, 2017; McNaughton et al., 2016). Regarding gender differences, studies involving RST measurements revealed no statistically significant differences; however, the FFFS system showed slightly higher scores in female (e.g., McNaughton & Corr, 2014).

From a clinical perspective, dysfunctions in the RST systems are meaningfully associated with various psychopathological conditions. BAS has been associated with high impulsivity, psychopathy, sensation-seeking traits, and symptoms of addiction (e.g., Alimoradi et al., 2011; Broerman et al., 2014; Mitchell & Nelson-Gray, 2005). As psychometric and neurobiological studies have shown, FFFS dysfunction is associated with psychopathological fear responses, as seen in specific phobias and social anxiety disorders (e.g., Donahue, 2020). Meanwhile, BIS dysfunction is strongly implicated in distress-related conditions, including depression, generalized anxiety disorder, obsessive-compulsive disorder, and post-traumatic stress disorder (e.g., Maack et al., 2011; Pinto-Meza et al., 2005).

1.1. Assessing the neurobehavioral systems BIS, FFFS and BAS: the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ)

Several psychometric measures have been developed to assess individual differences in RST neurobehavioral systems, resulting in a broad array of available tools (for a detailed review, see Alblas et al., 2025; Corr, 2016). Among these, the BIS/BAS scales (Carver & White, 1994) evaluate these two systems with questionable (George & Mallerey, 2003) satisfactory reliability indices (α = 0.66–0.74; Carver & White, 1994; the BAS scale is composed of three subscales: Reward Responsiveness, Drive, and Fun Seeking).

Different tools were developed both before and after the publication of the revised RST, incorporating the fundamental distinction between FFFS and BIS. The Jackson-5 (Jackson, 2009) comprises five scales—BAS, BIS, Flight, Fight, and Freezing—and has good internal consistency (α = 0.70–0.83). Similarly, the Revised Reinforcement Sensitivity Theory Questionnaire (rRST-Q; Reuter et al., 2015) includes scales for BIS, BAS, Fight, Flight, and Freezing, with moderate to good reliability indices (α = 0.52–0.76). A major limitation of both the Jackson 5 and the rRST-Q is that they do not adequately capture the multidimensionality of BAS, which is crucial from both a psychometric and theoretical perspective (Carver & White, 1994; Corr, 2008).

In contrast, the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ; Corr & Cooper, 2016) includes a defensive factor (consisting of the BIS and FFFS scales) and a four-factor BAS model defined by Reward Interest (RI), Goal-Drive Persistence (GDP), Reward Reactivity (RR), and Impulsivity (IMP). The RST-PQ has strong reliability indices (α = 0.74–0.93). In addition, Corr (2016) has highlighted another key limitation of the Jackson-5 and the rRST-Q: their weak psychometric and construct validity in assessing the FFFS and BIS factors. For example, with the Jackson-5, the correlations between the BIS scale and the Freezing and Flight scales are close to zero (Jackson, 2009), which means that the scales do not reflect the theoretical interplay between these systems (Corr, 2008). Similarly, the rRST-Q shows a strong negative correlation between the Fight subcomponent and FFFS (Reuter et al., 2015), suggesting that the Fight scale reflects predatory rather than a defensive motivation (Corr, 2016).

1.2. Relationship between the Reinforcement Sensitivity Theory–Personality Questionnaire and other personality frameworks

One of the most comprehensive and established frameworks of personality is the Big Five model (McCrae & Costa, 1999). Based on factor-analytic methods of adjective ratings, the Big Five taxonomy includes the dimensions of Neuroticism, Openness to Experience, Extraversion, Agreeableness, and Conscientiousness. Compared to the original BFI, the BFI-2 taxonomy (Soto & John, 2017) introduces revised dimension labels—Negative Emotionality, Open-Mindedness, Extraversion, Agreeableness, and Conscientiousness—thereby enhancing conceptual clarity and interpretability.

Because the Big Five traits are primarily descriptive, their motivational underpinnings have been explored within the framework of Reinforcement Sensitivity Theory (RST). Corr (2013) proposed that Extraversion and Neuroticism reflect sensitivity to approach (BAS) and avoidance (FFFS and BIS), respectively. Openness to Experience may be linked to BAS, due to its association with reward sensitivity. Agreeableness may involve both BAS and punishment sensitivity, reflecting prosocial motivation and discomfort with others' distress. Conscientiousness may relate to both approach motivation—via goal-directed behavior—and the regulation of negative affect.

In their validation of the RST-PQ, Corr and Cooper (2016) found that Neuroticism correlated negatively with Reward Interest (RI) and positively with FFFS and BIS. Extraversion correlated positively with RI, Reward Reactivity (RR), and Impulsivity (IMP). Conscientiousness showed a positive correlation with Goal-Drive Persistence (GDP) and a negative one with IMP. Openness correlated positively with RI, while Agreeableness showed no significant associations with RST-PQ scales.

Another explanatory perspective of personality —grounded in both neurobiological and evolutionary systems— is Affective Neuroscience (Panksepp, 1998). This framework describes seven basic emotional systems, each rooted in subcortical brain structures. The negative-affect systems include FEAR, SADNESS, and ANGER, whereas SEEK, PLAY, LUST, and CARE comprise the positive-affect systems. SEEK motivates individuals to pursue resources; PLAY fosters the development of social bonds and skills; LUST drives sexual and reproductive behaviors; and CARE underlies maternal and parental bonding. Conversely, ANGER arises from frustration when one's resources or safety are threatened; FEAR triggers avoidance and flight responses to potential harm; and SADNESS mediates social distress.

To assess individual differences in these emotional systems, Davis et al. (2003) developed the Affective Neuroscience Personality Scales (ANPS), a self-report questionnaire assessing six of the seven primary emotions (SEEK, PLAY, CARE, FEAR, SADNESS, and ANGER). Subsequent iterations—such as the 36-item ANPS Short Form (ANPS-S; Pingault et al., 2012)—were developed to enhance brevity and validity while preserving psychometric properties comparable to those of the original instrument.

1.3. The current study

Among the newly developed measures of the revised RST, the RST-PQ appears to have the most robust psychometric and construct properties for assessing BIS, BAS components, and FFFS. Based on this evidence, the current study aims to investigate the theoretical and psychometric properties of the RST-PQ in an Italian community sample.

1.3.1. Hypotheses

H1. Consistent with existing literature, FFFS activation is expected to be broadly similar across genders, although a slight tendency toward higher scores in females may occur. While studies using RST-based

questionnaires (e.g., McNaughton & Corr, 2014) generally report no statistically significant gender differences in FFFS scores, some evidence suggests marginally higher scores among females.

H2. a. The Italian version of the RST-PQ is expected to demonstrate satisfactory psychometric properties, as indicated by high internal consistency and a factor structure closely aligned with that of the original RST-PQ.

b. BAS is expected to be best represented by four distinct subscales—Reward Interest (RI), Reward Reactivity (RR), Goal-Drive Persistence (GDP), and Impulsivity (IMP)—rather than a single overarching BAS factor. Similarly, the FFFS and BIS systems are hypothesized to emerge as two separate factors, rather than a unified "Negative Affectivity" dimension.

H3. a. Convergent validity with the Big Five Inventory–2 (BIF-2; Perugini et al., 2021)

Specifically, we expect that:

- BAS-RI correlate positively with Extraversion and Open Mindedness, and negatively with Negative Emotionality.
- BAS-GDP correlate positively with Extraversion and Conscientiousness.
- BAS-IMP correlate positively with Extraversion and negatively with Conscientiousness.
- FFFS and BIS would correlate positively with Negative Emotionality.

b. Convergent validity with the Affective Neuroscience Personality Scales–Short Form (ANPS-S; Giacolini et al., manuscript submitted for publication) in line with the evolutionary–neurobiological perspective.

Specifically, we expect:

- FFFS correlate positively with FEAR and/or ANGER.
- BIS correlate positively with SADNESS and FEAR.
- SEEK, CARE, and PLAY correlate positively with all BAS subcomponents (i.e., RI, RR, GDP, and IMP).

2. Method

2.1. Participants

The sample consisted of 332 participants (208 female) ranging in age from 18 to 77 ($M_{age} = 32$; $SD_{age} = 14.03$) (see Table 1). Participants gave their written informed consent to participate in the study, which was approved by the Institutional Review Board of the University of Turin, Italy (prot. number: 0420699).

2.2. Measures

2.2.1. Reinforcement Sensitivity Theory – Personality Questionnaire (RST-PQ; Corr & Cooper, 2016)

The RST-PQ is a self-report questionnaire consisting of 65 items associated with a four-point Likert scale ranging from (1) "not at all" to (4) "to a great extent". The RST-PQ consists of several subscales that assess the Behavioral Inhibition System (BIS; e.g., *I am often preoccupied with unpleasant thoughts*), the Fight-Flight-Freeze System (FFFS; e.g., *I would be frozen to the spot by the sight of a snake or spider*), and four BAS scales called Reward Interest (RI; e.g., *I am a very active person*), Goal-Drive Persistence (GDP; e.g., *I put in a big effort to accomplish important goals in my life*), Reward Reactivity (RR; e.g., *Sometimes even little things in life can give me great pleasure*), and Impulsivity (IMP; e.g., *I think I should 'stop and think' more instead of jumping into things too quickly*). RST-PQ showed good internal consistency in terms of Cronbach alpha that ranges from 0.74 to 0.93.

Table 1
Sample sociodemographic characteristics (N = 332).

	Participants
Gender	
M	n = 124 (37.3 %)
F	n = 208 (62.7 %)
Age	
Range	18–77
M	32
SD	14.03
Marital status	
Single	233 (70.2 %)
Cohabitant	34 (10.2 %)
Married	54 (16.3 %)
Divorced	9 (2.7 %)
Widower	2 (0.6 %)
Occupation	
Student	136 (41 %)
Employee	157 (47.3 %)
Retired	21 (6.3 %)
Unemployed	18 (5.4 %)
Education	
No formal education	2 (0.6 %)
Lower secondary school diploma	14 (4.2 %)
High school diploma	140 (42.2 %)
Bachelor's degree	97 (29.2 %)
Master's degree	64 (19.3 %)
Post-lauream education	15 (4.5 %)

2.2.2. Affective Neuroscience Personality Scales – Short form, Italian version (ANPS-S; Giacolini et al., manuscript submitted for publication; Pingault et al., 2012)

The ANPS-S is a self-report questionnaire designed to measure six fundamental emotional systems based on affective neuroscience theory. The ANPS-S demonstrates internal consistency ranging from questionable to good, with Cronbach's alpha coefficients between 0.60 and 0.87 (Pingault et al., 2012). The questionnaire consists of 36 items rated on a 4-point Likert scale, from (0) "strongly disagree" to (3) "strongly agree." These systems include: CARE, reflecting nurturing tendencies and caregiving behaviors, often associated with maternal instincts (e.g., *I often feel a strong need to take care of others*); PLAY, which captures a disposition toward joy, laughter, and active social engagement (e.g., *I am a person who is easily amused and laughs a lot*); SEEK, representing a drive for exploration, curiosity, and enthusiasm for new experiences (e.g., *I really enjoy looking forward to new experiences*); SADNESS, related to feelings of separation, loneliness, and grief, capturing emotional pain associated with loss or isolation (e.g., *I often feel sad*); FEAR, encompassing anxiety, threat sensitivity, and difficulty in decision-making (e.g., *People who know me well would say I am an anxious person*); ANGER, assessing tendencies toward irritation and frustration (e.g., *When I am frustrated, I usually get angry*).

2.2.3. Big Five Inventory – 2 (BFI-2; Soto & John, 2017; Italian translation by Perugini et al., 2021)

The BFI-2 is a personality self-report inventory that measures the five Big Five domains (extraversion, i.e., …*Is outgoing, sociable*; agreeableness, i.e., …*Is compassionate, has a soft heart*; conscientiousness, i.e., … *Is systematic, likes to keep things in order*; negative emotionality, i.e., … *Is moody, has up and down mood swings*; and Open-Mindedness, i.e., … *Is curious about many different things*). The BFI-2 consists of 60 items with a five-point Likert scale ranging from (1) "strongly disagree" to (5) "strongly agree". The BFI-2 demonstrated satisfactory average alpha reliability of 0.86.

2.3. Procedure

Participants were recruited through flyers and announcements on social media, and the study was conducted entirely online. Data were collected via a Google form that included a consent form, a

sociodemographic questionnaire and the self-report measures (ANPS-S, RST-PQ and BFI-2). To assess potential response distortions in the questionnaires, we applied the *LongString* function, which identifies the longest string of identical consecutive responses for each observation (e.g., Johnson 2005; Niessen et al., 2016). Specifically, we set the cut-off at the 95th percentile of the total number of responses for each questionnaire. The LongString function indicated that three individuals exceeded the cut-off in three questionnaires, while two participants exceeded it in two questionnaires. Additionally, guidelines for tele-assessment (e.g., APA, 2024) and ethical standards (APA, 2017) were followed; participants were instructed to ensure a stable internet connection and to be in a private room, disable mobile and browser notifications, and refrain from using their phones throughout the entire experimental procedure.

The Italian translation of the Reinforcement Sensitivity Theory-Personality Questionnaire was developed in accordance with the guidelines for the translation of questionnaires and their adaptation to another language (Denissen et al., 2008). The translation process involved two iterative steps. First, two independent mother-tongue translators translated the original RST-PQ into Italian. Discrepancies between the translations were resolved by consensus. Next, the translated version was back-translated into English by two other independent native-speaking translators to ensure consistency with the original RST-PQ.

2.4. Data analysis

Analysis was conducted using R software with the *lavaan* (Rosseel, 2012), *semTools* (Jorgensen et al., 2012), *psych* (Revelle, 2025), *stats* (R Core Team, 2024), and *dplyr* (Wickham et al., 2023) packages. To assess the factorial structure of the Italian RST-PQ, a series of confirmatory factor analyses (CFA) were performed using the Weighted Least Squares Mean and Variance adjusted (WLSMV) estimator, consistent with the original paper describing the RST-PQ (Corr & Cooper, 2016). The goodness of fit for the models was evaluated using the $\chi 2$ statistic, the robust Root Mean Square of Approximation (RMSEA), the robust Comparative Fit Index (CFI), and the robust Tucker-Lewis Index (TLI). Specifically, we considered RMSEA values <0.08 as indicative of acceptable fit, whereas RMSEA <0.05 represented good fit. CFI and TLI values >0.90 indicated good fit, while values >0.95 were interpreted as an optimal fit (e.g., Brown, 2014). We also set the a priori threshold for factor loading to 0.30 or higher (e.g. Brown, 2014).

For the CFAs, we compared solutions with multiple and single factors for both the positive and negative systems. Specifically, we tested a single BAS factor against a four-factor solution (RI, GDP, RR and I factors) and a single Negative Affects factor against a two-factor solution (BIS and FFFS factors). These analyses mirror those conducted in the original RST-PQ study and in other adaptation studies (e.g., Corr & Cooper, 2016; Wytykowska et al., 2017). In addition, a comprehensive CFA model including all scales (RI, GDP, RR, IMP, BIS and FFFS) was tested to assess overall model fit.

3. Results

3.1. Italian version of the RST-PQ and internal consistency

Table 2 presents the correlations between the Italian RST-PQ scales - which closely align with those reported by Corr and Cooper (2016) study and the correlations of RST-PQ scales to age and gender. Regarding the latter, females scored higher than males on Behavioral Approach System – Impulsivity, the Behavioral Inhibition System, and the Fight-Flight-Freeze System, and even after applying the False Discovery Rate (FDR) correction ($r = 0.12$; $r = 0.21$ and $r = 0.43$, respectively); non-significant gender differences were observed for BAS-RR, BAS-GDP, BAS-RI (with females showing slightly higher scores). Additionally, the reliability values assessed using Cronbach's α are consistent with those of the original version.

3.2. Confirmatory factor analysis

3.2.1. One BAS factor vs four Reward Interest, Reward Reactivity, Goal Drive Persistence and Impulsivity factors

The results of the CFA for the one-factor model indicated a poor fit ($\chi^2 = 1282.84$, $p \leq .001$; CFI = 0.86; TLI = 0.62; RMSEA = 0.086; 90 % Confidence Interval [C.I.] = 0.080–0.091). In contrast, the four-factor solution demonstrated an improved fit ($\chi^2 = 874.51$, $p \leq .001$; CFI = 0.93; TLI = 0.93; RMSEA = 0.060; 90 % Confidence Interval [C.I.] = 0.054–0.066). The results indicate that the four-factor model fits the data better than the one-factor model, $\Delta\chi^2$ (6) = 174.15, $p < .001$, supporting the multidimensional structure of the BAS.

3.2.2. One Negative Affectivity factor One Negative Affectivity factor vs two Behavioral Inhibition System and Fight-Flight-Freeze System factors

In this latter case, the CFA results for the two-factor solutions encompassing the BIS and FFFS factors ($\chi^2 = 1047.61$, $p \leq .001$; CFI =

Table 2
Italian RST-PQ scales correlations and Cronbach's α.

	BAS-RR	BAS-GDP	BAS-IMP	BAS-RI	BIS	FFFS
BAS-RR	1	0.45 (<0.001)	0.49 (<0.001)	0.47 (<0.001)	0.30 (<0.001)	0.18 (0.001)
BAS-GDP	–	1	0.20 (<0.001)	0.50 (<0.001)	0.06 (0.342)	0.13 (0.027)
BAS-IMP			1	0.45 (<0.001)	0.25 (<0.001)	0.22 (<0.001)
BAS-RI				1	−0.04 (0.518)	−0.03 (0.642)
BIS					1	0.44 (<0.001)
FFFS						1
Cronbach's α	0.76	0.86	0.70	0.85	0.94	0.79
M	27.77	21.07	18.72	19.08	59.77	25.34
SD	4.86	4.24	4.14	4.43	14.32	6.00
r w/age	−0.28 (<0.001)	−0.19 (0.001)	−0.03 (0.642)	−0.05 (−0.471)	−0.31 (<0.001)	0.09 (0.117)
r w/gender	0.1 (0.099)	0.15 (0.010)	0.12 (0.035)	−0.03 (0.569)	0.21 (<0.001)	0.43 (<0.001)

Note. FFFS = Fight-Flight-Freeze System; BIS = Behavioral Inhibition System; BAS-RI = Behavioral Approach System – Reward Interest; BAS-GDP = Behavioral Approach System – Goal Drive Persistence; BAS-RR = Behavioral Approach System – Reward Reactivity; BAS-IMP = Behavioral Approach System – Impulsivity. Gender: Male = 0; Female = 1.

* Results that remained statistically significant after applying the False Discovery Rate (FDR) correction to control for Type I error.

0.98; TLI = 0.98; RMSEA = 0.060; 90 % Confidence Interval [C.I.] = 0.055–0.065) showed a better fit compared to the one-factor solution - i.e., one negative factor - ($\chi^2 = 1393.14$, $p \leq .001$; CFI = 0.96; TLI = 0.96; RMSEA = 0.077; 90 % Confidence Interval [C.I.] = 0.072–0.082) both in terms of absolute and relative fit indices. A chi-square difference test indicated that the two-factor model fits the data significantly better than the one-factor model, $\Delta\chi^2(1) = 60.79$, $p < .001$.

3.2.3. Unitary model

The fit indices for the unitary model encompassing all the BAS-RR, BAS-GDP, BAS-IMP, BAS-RI, BIS, and FFFS scales were acceptable ($\chi^2 = 3170.973092.476$, $p \leq .001$; CFI = 0.90; TLI = 0.90; RMSEA = 0.067; 90 % Confidence Interval [C.I.] = 0.062–0.071). Consistent with the ultimate model presented in the original RST-PQ publication (Corr & Cooper, 2016), all factors were allowed to correlate freely.

The factor loadings for all items are presented in Appendix A. Almost all items demonstrated a factor loading above our a priori threshold of 0.30 or higher (e.g. Brown, 2014), with the exception of RST-PQ_40 ("Compro sempre cose d'impulso").

3.3. Correlation with BFI-2 and ANPS-S factor scores

The correlations between RST-PQ and BFI-2 were conducted using FDR correction (Table 3). Agreeableness correlated with BIS ($r = 0.17$; $p = .002$); BAS-RI ($r = 0.15$; $p = .007$); BAS-GDP ($r = 0.13$; $p = .029$). Negative Emotionality was found to be positively and significantly correlated with both FFFS ($r = 0.36$; $p < .001$), BIS ($r = 0.78$; $p < .001$), and BIS-RR ($r = 0.13$; $p = .029$) while a significant negative correlation emerged between Negative Emotionality and BAS-RI ($r = -0.27$; $p < .001$). Conversely, Extraversion was significantly correlated with BIS ($r = -0.25$; $p < .001$), BAS-RI ($r = 0.49$; $p < .001$), BAS-GDP ($r = 0.37$; $p < .001$), and BAS-RR ($r = 0.34$; $p < .001$), Open-Mindedness was significantly and positively correlated with BIS ($r = 17$; $p = .003$), BAS-RI ($r = 0.40$; $p < .001$), BAS-GDP ($r = 0.24$; $p < .001$), BAS-RR ($r = 0.29$; $p < .001$), and BAS-IMP ($r = 0.17$; $p = .003$). Finally, significant positive correlations were identified between Conscientiousness and BAS-RI ($r = 0.20$; $p < .001$) and BAS-GDP ($r = 0.44$; $p < .001$), while Conscientiousness was found to be significantly and negatively correlated with BIS ($r = -0.20$; $p < .001$) and BAS-IMP ($r = -0.24$; $p < .001$).

Table 4 presents the FDR-corrected correlations between RST-PQ and ANPS-S. FFFS was found to be positively and significantly correlated with FEAR ($r = 0.38$; $p < .001$) and SADNESS ($r = 0.36$; $p < .001$), and negatively with SEEK ($r = -0.15$; $p = .008$). Similarly, BIS was significantly correlated with FEAR ($r = 0.77$; $p < .001$), SADNESS ($r = 0.78$; $p < .001$), and ANGER ($r = 0.25$; $p < .001$) scales. SEEK was positively and significantly correlated with BAS-RI ($r = 0.66$; $p < .001$), BAS-GDP ($r = 0.42$; $p < .001$), BAS-RR ($r = 0.39$; $p < .001$), and BAS-IMP ($r = 0.25$; $p < .001$). Also, SADNESS correlated negatively with BAS-RI ($r = -0.15$; $p = .008$), and positively with BAS-RR ($r = -0.14$; $p = .019$) and BAS-IMP ($r = -0.12$; $p = .043$) In addition, positive and significant correlations were observed between CARE, BAS-RI ($r = 0.23$; $p < .001$), BAS-GDP ($r = 0.25$; $p < .001$), BAS-RR ($r = 0.15$; $p < .008$), and BAS-IMP ($r = 0.15$; $p < .008$). Finally, PLAY was found to be positively and significantly correlated with BAS-RI ($r = 0.42$; $p < .001$), BAS-GDP ($r = 0.27$; $p < .001$), BAS-RR ($r = 0.42$; $p < .001$), BAS-IMP ($r = 0.25$; $p < .001$), and negatively with BIS ($r = -0.12$; $p = .34$) scales.

4. Discussion

The aim of the current study was to adapt and examine the psychometric properties of the Italian version of the Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ) and then relate it to other established measures of personality. Specifically, we investigated the internal consistency, factor structure, and convergent validity of the RST-PQ in relation to other established personality measures.

4.1. Hypothesis 1

Contrary to our initial hypothesis that FFFS activation would be broadly similar across genders, with at most a slight tendency toward higher scores in females (McNaughton & Corr, 2014), correlation analyses revealed significant gender differences on the BAS-IMP, BIS, and FFFS scales. Specifically, females scored significantly higher than males on the Behavioral Approach System – Impulsivity, the Behavioral Inhibition System, and the Fight-Flight-Freeze System, even after applying the FDR correction. These findings suggest greater reactivity and heightened sensitivity to punishment and threat among female participants. In contrast, only small, non-significant gender differences emerged for BAS-RR, BAS-GDP, and BAS-RI. However, as measurement invariance was not tested, these results should be interpreted with caution.

4.2. Hypothesis 2

The Italian version of the RST-PQ demonstrated good psychometric properties in terms of internal consistency and factor structure. Reliability analyses showed that all scales achieved good to excellent values, comparable to those reported in the original RST-PQ validation study (Corr & Cooper, 2016).

Confirmatory factor analyses (CFA) supported the factorial structure proposed by Corr and Cooper (2016), with acceptable model fit indices (CFI, TLI, and RMSEA) that met our predefined benchmarks for acceptability. Interestingly, our findings showed slightly higher fit indices than those reported in the original validation study.

Notably, the Italian RST-PQ demonstrated the multidimensionality of the BAS and FFFS/BIS constructs, aligning with the theoretical

Table 3
Correlations between RST-PQ and BFI-2 (N = 332).

	Agreeableness	Extraversion	Negative Emotionality	Conscientiousness	Open Mindedness
FFFS	−0.01	−0.01	0.36	0.04	−0.02
	(0.990)	(0.091)	(<0.001)	(0.532)	(0.732)
BIS	−0.17	−0.25	0.78	−0.20	0.17
	(0.002)	(<0.001)	(<0.001)	(<0.001)	(0.003)
BAS-RI	0.15	0.49	−0.27	0.20	0.40
	(0.007)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
BAS-GDP	0.13	0.37	−0.10	0.44	0.24
	(0.029)	(<0.001)	(0.100)	(<0.001)	(<0.001)
BAS-RR	0.01	0.34	0.13-	−0.04	0.29
	(0.072)	(<0.001)	(0.029)	(0.481)	(<0.001)
BAS-IMP	−0.10	0.29	0.07	−0.24	0.17
	(0.072)	(<0.001)	(0.209)	(<0.001)	(0.003)

Note. FFFS = Fight-Flight-Freeze System; BIS = Behavioral Inhibition System; BAS-RI = Behavioral Approach System – Reward Interest; BAS-GDP = Behavioral Approach System – Goal Drive Persistence; BAS-RR = Behavioral Approach System – Reward Reactivity; BAS-IMP = Behavioral Approach System – Impulsivity.
* Results that remained statistically significant after applying the False Discovery Rate (FDR) correction to control for Type I error.

Table 4
Correlation between RST-PQ and ANPS-S (N = 332).

	SEEK	FEAR	CARE	PLAY	ANGER	SADNESS
FFFS	−0.15	0.38	0.05	−0.01	0.09	0.36
	(0.008)	(<0.001)	(0.366)	(0.793)	(0.133)	(<0.001)
BIS	−0.04	0.77	0.03	−0.12	0.25	0.78
	(0.490)	(<0.001)	(0.623)	(0.034)	(<0.001)	(<0.001)
BAS-RI	0.66	−0.14	0.23	0.42	−0.20	−0.15
	(<0.001)	(0.017)	(<0.001)	(<0.001)	(0.001)	(0.008)
BAS-GDP	0.42	0.07	0.25	0.27	−0.08	−0.04
	(<0.001)	(0.227)	(<0.001)	(<0.001)	(0.204)	(0.470)
BAS-RR	0.39	0.18	0.15	0.42	0.05	0.14
	(<0.001)	(0.002)	(0.008)	(<0.001)	(*0.390*)	(0.019)
BAS-IMP	0.25	0.06	0.15	0.25	- 0.09	0.12
	(<0.001)	(0.366)	(0.008)	(<0.001)	(0.132)	(0.043)

Note. FFFS = Fight-Flight-Freeze System; BIS = Behavioral Inhibition System; BAS-RI = Behavioral Approach System – Reward Interest; BAS-GDP = Behavioral Approach System – Goal Drive Persistence; BAS-RR = Behavioral Approach System – Reward Reactivity; BAS-IMP = Behavioral Approach System – Impulsivity.
* Results that remained statistically significant after applying the False Discovery Rate (FDR) correction to control for Type I error.

rationale of the revised Reinforcement Sensitivity Theory (Corr, 2008, 2016; Corr & Cooper, 2016). Specifically, BAS items showed a better fit when modeled as four distinct factors rather than unidimensional construct. Similarly, BIS and FFFS items fit better as two distinct latent factors rather than a single negative factor. These findings suggest that the BAS is best represented by four separate factors rather than a single unified construct, while the BIS and the FFFS are more accurately modeled as two distinct latent factors. This aligns with the revised RST framework, which is supported by neuropharmacological (e.g., Perkins et al., 2009), functional (Corr & McNaughton, 2012), and psychometric evidence (Cooper et al., 2007). Overall, these results reinforce the notion that approach and avoidance behaviors are driven by multiple underlying processes rather than a simple dichotomy.

4.3. *Hypothesis 3*

To assess convergent validity, we examined correlations between the Italian RST-PQ and other established personality measures. The correlations with the Big Five traits, measured using the Big Five Inventory-2 (BFI-2; Soto & John, 2017), replicated patterns observed in the original study by Corr & Cooper (2017). Specifically, BAS-related scales (Reward Interest, Goal-Drive Persistence, Reward Reactivity, and Impulsivity) were positively correlated with Extraversion and Open-Mindedness, consistent with prior findings linking these traits to reward sensitivity and the pursuit of novel experiences (Corr, 2013; DeYoung et al., 2010). Similarly, Negative Emotionality was positively correlated with both FFFS and BIS, reflecting their shared association with negative affectivity (e.g., Alblas et al., 2025).

Correlations between the RST-PQ and the Affective Neuroscience Personality Scales (ANPS-S; Pingault et al., 2012) provided further insights into the evolutionary and neurobiological foundations of human personality (Corr, 2008; Davis & Montag, 2018; Panksepp, 1998). Positive correlations between ANPS-S Positive Affectivity and BAS subscales highlight their shared focus on pleasurable and rewarding stimuli, particularly those linked to the SEEK (anticipation of reward and enthusiasm) and PLAY (social engagement and joy) systems (Panksepp, 1998). A particularly noteworthy finding was the pattern of correlations between the ANPS-S SADNESS and FEAR scales and the RST-PQ FFFS and BIS scales. These results align with the theoretical and neurobiological underpinnings of the constructs, as all these scales operationalize distinct brain circuits that are involved in specific emotional responses, subjective experiences, and behavioral tendencies (Corr, 2008; Gray & McNaughton, 2000).

Consistent with our expectations, all negative scales were correlated, reflecting shared underlying mechanisms of negative affectivity. Importantly, we observed a strong correlation between FEAR and FFFS ($r = 0.38$) and between SADNESS and BIS ($r = 0.78$), which suggests that these scales are sensitive to the distinct neurobiological and psychometric constructs of fear and distress. However, the particularly high correlations between both SADNESS and FEAR with the BIS scale ($r = 0.78$ and $r = 0.77$, respectively) may highlight the challenge of fully disentangling anxiety and fear on a psychometric level. This overlap is well-documented in the literature, where anxiety and fear often share significant variance (e.g., Blanco et al., 2015; Kotov et al., 2011). Nevertheless, the RST-PQ's ability to identify and measure these constructs as separate latent dimensions (BIS and FFFS) reflects its theoretical alignment with the revised Reinforcement Sensitivity Theory (Corr, 2016; Corr & Cooper, 2016), which distinguishes fear-driven responses from those related to distress and avoidance.

From a clinical perspective, the RST-PQ's ability to capture the multidimensionality of approach (e.g., RI, GDP, RR, and IMP scales) and avoidance (e.g., FFFS and BIS scales) motivations are particularly valuable. Dimensional frameworks in psychopathology have emphasized the importance of distinguishing fear-related and distress-related constructs, although they converge within a broader internalizing factor (Kotov et al., 2021). The availability of tools like the RST-PQ, which can differentiate these dimensions, may significantly advance research and clinical practice in psychopathology.

4.4. *Final considerations*

The Italian RST-PQ could be used both in research and in a clinical context in the Italian population. In particular, its ability to differentiate between BIS and FFFS constructs offers valuable insights for investigating and understanding motivations, reactivity, and tendencies under conditions characterized by distress and fear-related phenomena. Future research, grounded in RST and the neurobiological perspective of personality, could further enhance the utility of the RST-PQ by examining its test-retest reliability and its application to different sample characteristics.

The findings of this study should be interpreted in light of several limitations. First, we acknowledge that formal measurement invariance across gender was not tested in the present study. Therefore, gender comparisons should be interpreted with caution. Future research is needed to determine whether the constructs measured operate equivalently across genders before drawing definitive conclusions. Second, regarding *constraints on generality* (Simons et al., 2017), the psychometric properties of the Italian version of the RST-PQ were examined using a relatively small sample size without stratification by socioeconomic status and regional affiliation in order to ensure generalizability. Future studies should aim to replicate these findings considering sociodemographic and socioeconomic characteristics samples and the translation may benefit from further refinement in future research. Finally, the test-retest reliability of the Italian version of the RST-PQ was not evaluated. Future studies should replicate the factor analysis results and conduct test-retest stability analyses in both clinical and non-

clinical. However, previous adaptation studies with similar validation procedures have demonstrated satisfactory reliability and validity parameters (e.g., Wytykowska et al., 2017).

CRediT authorship contribution statement

Lorenzo Brienza: Writing – original draft, Formal analysis, Conceptualization. **Alessandro Zennaro:** Writing – review & editing. **Andrew Cooper:** Writing – review & editing. **Philip J. Corr:** Writing – review & editing. **Agata Andò:** Writing – original draft, Writing – review & editing, Conceptualization.

Ethical approval

All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Participants gave their written informed consent to participate in the study, which was approved by the Institutional Review Board of the University of Turin, Italy (prot. number: 0420699).

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Declaration of competing interest

The authors declare no potential conflict of interest.

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None.

Appendix A. Factor loadings for CFA of RST-PQ items

RST-PQ items	CFA					
	BAS-RR	BAS-GDP	BAS-IMP	BAS-RI	BIS	FFFS
RSTPQ_3	0.30					
RSTPQ_4	0.41					
RSTPQ_8	0.44					
RSTPQ_16	0.33					
RSTPQ_23	0.50					
RSTPQ_24	0.48					
RSTPQ_25	0.51					
RSTPQ_30	0.53					
RSTPQ_36	0.39					
RSTPQ_37	0.34					
RSTPQ_5		0.50				
RSTPQ_12		0.67				
RSTPQ_20		0.57				
RSTPQ_31		0.69				
RSTPQ_41		0.62				
RSTPQ_54		0.32				
RSTPQ_65		0.60				
RSTPQ_22			0.33			
RSTPQ_27			0.63			
RSTPQ_28			0.41			
RSTPQ_38			0.51			
RSTPQ_40			0.28			
RSTPQ_44			0.43			
RSTPQ_51			0.42			
RSTPQ_53			0.44			
RSTPQ_11				0.61		
RSTPQ_13				0.61		
RSTPQ_14				0.65		
RSTPQ_15				0.59		
RSTPQ_26				0.39		
RSTPQ_32				0.66		
RSTPQ_35				0.55		
RSTPQ_1					0.59	
RSTPQ_2					0.66	
RSTPQ_6					0.73	
RSTPQ_7					0.46	
RSTPQ_10					0.63	
RSTPQ_17					0.52	
RSTPQ_18					0.47	
RSTPQ_21					0.67	
RSTPQ_29					0.67	
RSTPQ_33					0.53	
RSTPQ_34					0.73	
RSTPQ_42					0.62	
RSTPQ_43					0.60	
RSTPQ_47					0.76	
RSTPQ_49					0.41	
RSTPQ_50					0.55	
RSTPQ_55					0.52	

(*continued on next page*)

(*continued*)

RST-PQ items	CFA					
	BAS-RR	BAS-GDP	BAS-IMP	BAS-RI	BIS	FFFS
RSTPQ_56					0.71	
RSTPQ_57					0.57	
RSTPQ_60					0.62	
RSTPQ_61					0.73	
RSTPQ_63					0.60	
RSTPQ_64					0.51	
RSTPQ_9						0.39
RSTPQ_19						0.56
RSTPQ_39						0.56
RSTPQ_45						0.47
RSTPQ_46						0.41
RSTPQ_48						0.62
RSTPQ_52						0.54
RSTPQ_58						0.31
RSTPQ_59						0.46
RSTPQ_62						0.72

Note. FFFS = Fight-Flight-Freeze System; BIS = Behavioral Inhibition System; BAS-RI = Behavioral Approach System – Reward Interest; BAS-GDP = Behavioral Approach System – Goal Drive Persistence; BAS-RR = Behavioral Approach System – Reward Reactivity; BAS-IMP = Behavioral Approach System – Impulsivity.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2025.113408.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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