Neurobiologically Determined Temperamental Dimensions as Predictors of Autonomy and Sociotropy

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ABSTRACT

This study investigated relationships between neurobiologically determined temperament dimensions, as defined by Dr. Helen E. Fisher (Fisher Temperament Inventory, Fisher et al., 2015), and interpersonal orientations operationalized through autonomy and sociotropy (Sociotropy-Autonomy Scale, Beck et al., 1983). The main goal of the research was to expand our understanding of how neurobiological predispositions may manifest in distinct interpersonal and self-oriented psychological traits. We employed a cross-sectional non-experimental quantitative design. The final sample consisted of 161 full-time university students (80.7% female), with a mean age of 20.27 years (range: 18-24 years). Our findings revealed several significant relationships between the studied variables. The strongest relationship was found between the Negotiator temperament (estrogen-oxytocin) and Sociotropy, followed by Director (testosterone) and Sociotropy, Director and Autonomy, Explorer (dopamine) and Autonomy and Explorer. Director and Explorer temperaments collectively accounted for 13.3% of the variance in Autonomy, while the model incorporating Negotiator and Director (inverse) explained 27.1% of the variance in Sociotropy. Cluster analysis revealed two distinct clusters: the "Sociotropic Negotiator profile" and "Autonomous Director/Explorer profile." Additionally, women scored significantly higher in Sociotropy compared to men, with a large effect size. These findings align with previous empirical evidence on personality dimensions and their connection to Autonomy and Sociotropy. This investigation represents a preliminary attempt to explore these relationships through a neurobiological lens, specifically linking the testosterone-related dimension (Director) to Autonomy and the estrogen-oxytocin type (Negotiator) to Sociotropy.

Keywords: *personality, temperament, autonomy, sociotropy, behavioral endocrinology*

INTRODUCTION

Understanding the interplay between psychobiological predispositions and psychological functioning is fundamental to personality research. While numerous models strive to explain human personality, recent advancements in neurobiological research offer a new lens to explore these complexities. Specifically, Dr. Helen Fisher's neurohormonal temperament model offers a unique framework grounded in genetics, behavioral endocrinology, and neuroscience, outlining four distinct temperament dimensions linked to specific neurochemical and neurohormonal systems (Fisher, 2009; Fisher et al., 2012; Brown et al., 2015). Beyond these biological considerations, Aaron T. Beck's well-established concepts of Sociotropy and Autonomy have long been fundamental in understanding individual differences in interpersonal orientation and personal independence, with implications for personal well-being and mental health (Beck et al., 1983; Bieling et al., 2000). This study aims to bridge these theoretical perspectives by investigating the relationships between Fisher's temperament dimensions and Beck's Sociotropy and Autonomy constructs. We aim to enhance our understanding of how fundamental biological predispositions may manifest in distinct interpersonal and self-oriented psychological traits.

LITERATURE REVIEW

Neurobiological Model of Temperament

The neurohormonal temperament model of personality proposed by the American anthropologist Dr. Helen E. Fisher (2009) represents a unique psychological concept based on the findings of genetics, behavioral endocrinology, brain anatomy, and the physiology of neurotransmitter systems. Based on several empirical studies, including fMRI studies, the authors identified four distinctive temperamental dimensions that are related to specific types of neurotransmitters and/or hormonal systems: 1. Explorers (dopamine-norepinephrine), 2. Builders (serotonin), 3. Directors (testosterone), 4. Negotiators (estrogen-oxytocin) (Fisher et al., 2012, Brown et al., 2015).

The Explorer temperament is primarily associated with the dopamine-norepinephrine system (Fisher, 2009). This neurochemical system is linked to sensation seeking, enthusiasm, increased boredom susceptibility, and behavioral disinhibition (Zuckerman, 2005). Explorers desire new stimuli and experiences, displaying traits such as curiosity, high energy, motivation, optimism, adaptability, intellectual flexibility, and generosity.

However, they may also exhibit impulsivity, unpredictability, disorganization, and a tendency toward addictive behaviors (Fisher, 2009).

The Builder temperament is associated with the serotonin system's activation. Individuals exhibiting this type are typically characterized by caution, harm avoidance, and a strong adherence to social norms, customs, and authority. They also demonstrate religiosity, prosocial behavior, sociability, conformity (Fisher, 2009), self-control (Manuck et al., 1998), and a reduced need for novelty seeking (Serretti et al., 2007). Builders generally prefer order, precision, and detail; they are often described as conscientious, conventional, and loyal, thriving on planning and following established rules and traditions (Fisher, 2009).

Directors, whose traits are associated with prenatal priming of endogenous testosterone, exhibit higher levels of social dominance, assertiveness, and, in some contexts, antisocial and criminal behavior (Schaal et al., 1996). Fisher (2009) describes Directors as emotionally reserved, detail-oriented, and having a narrow range of interests. Their profile includes being autonomous, analytical, ambitious, assertive, courageous, direct, dominant, stubborn, self-confident, logical, focused, competitive, mathematically and technically proficient, decisive, skeptical, systematic, and demonstrating excellent spatial orientation.

The Negotiator temperament is connected to prenatal estrogen priming and oxytocin levels. Research indicates that estrogen activity correlates with traits such as contextual thinking, verbal fluency (Baron-Cohen et al., 2005), empathy, and prosocial behavior (Kendrick, 2000). This is further supported by estrogen's association with increased cerebral hemispheric connectivity and a lower 2D/4D ratio (Fisher et al., 2010). Negotiators are typically empathic, introspective, imaginative, intuitive, cooperative, agreeable, mentally flexible, and emotionally expressive, prioritizing interpersonal and social harmony, friendships, and strong relationships (Fisher, 2009).

Sociotropy and Autonomy

The concepts of Sociotropy and Autonomy, as formulated by Aaron T. Beck, represent two distinct personality traits that significantly influence an individual's psychological functioning and their susceptibility to emotional disorders, particularly depression (Beck et al., 1983; Bieling et al., 2000).

Sociotropy involves an investment in positive interpersonal relationships and a reliance on social feedback to satisfy emotional needs. Sociotropic individuals place high

importance on closeness and support from others and are motivated to maintain interpersonal relationships. These individuals can be vulnerable to depression when they experience relationship loss or rejection (Beck et al., 1983). Beck (1983) conceptualized sociotropy as a combination of beliefs, behavioral dispositions, and attitudes that orient individuals toward seeking attention from and relying upon others for personal fulfillment. Sociotropy is further characterized by an individual's focus on interpersonal interactions involving intimacy, sharing, empathy, understanding, affection, protection, guidance, and help. Sociotropic individuals tend to place importance on seeking approval from others and on trying to avoid disapproval from others as much as possible (Beck, 1983).

Individuals with higher sociotropy scores demonstrate increased levels of neuroticism, characterized by heightened emotional reactivity, anxiety, and sensitivity to interpersonal dynamics (Cappeliez, 1993). This emotional vulnerability appears to fuel a compensatory reliance on external approval and social connection as regulatory mechanisms. Sociotropy has been significantly correlated with higher harm avoidance, reward dependence and self-transcendence, and lower self-directedness in the Temperament and Character Inventory (Otani et al., 2011) and negatively with openness to experience (Cappeliez, 1993). According to Moore and Blackburn (1994), sociotropy is associated with depressive symptomatology (independently of anxiety level), negative automatic thoughts, dysfunctional attitudes, and neuroticism. Connor-Smith and Compas (2002) found that sociotropic individuals are more vulnerable to social stress and social anxiety. Furthermore, sociotropy has been associated with all Symptom Checklist-90 R scales (Moore & Blackburn, 1994).

Sociotropic individuals value interpersonal harmony and prioritize others' satisfaction, preferences that align closely with agreeableness traits. This orientation may manifest in pronounced people-pleasing behaviors, as demonstrated by Exline et al. (2012), who found that sociotropy predicts increased eating in response to perceived social pressure. These individuals also exhibit a strong need for external validation while demonstrating heightened sensitivity to potential conflict situations, often giving in to social pressure (Otani et al., 2014). Their quest for validation through others' satisfaction may paradoxically undermine their self-worth. When self-esteem becomes dependent on external approval, individuals may develop negative self-perceptions, experiencing feelings of inadequacy, helplessness, or resentment. This dynamic can ultimately compromise self-

care behaviors, as the person's focus remains externally oriented rather than attending to their own needs and well-being (Bowlby, 1977).

Sociotropic tendencies have been linked to various mental health conditions, including anxiety and depression, avoidant personality disorder, borderline personality disorder, and co-dependency or dependent personality disorder (Trull & Widiger, 2013).

Autonomy represents an orientation towards personal independence, individuality, self-reliance, control, and the achievement of personal goals (Beck, 1983). Individuals who are autonomous tend to place great importance on self-definition and tendency to emphasize one's own personal needs and rights. Autonomous individuals find satisfaction in self-reliance and personal accomplishments. They can be vulnerable to depression when they perceive threats to their independence or an inability to achieve their goals (Beck et al., 1983; Bieling et al., 2000). In the Moore and Blackburn (1994) study, autonomy showed no significant relationships with depressive or anxiety symptoms, yet it was associated with reduced extraversion and exhibited stronger connections to perfectionist orientations compared to social approval concerns. On the Temperament and Character Inventory (Cloninger et al., 1994), autonomy was significantly correlated with higher persistence and self-transcendence, and lower reward dependence (Otani et al., 2011). Autonomy demonstrated significant associations with the Big Five traits of extraversion, conscientiousness, and emotional stability (Ramsey & Hall, 2016).

Research Goal

The main aim of the study was to explore potential relationships between Fisher's temperament model and Beck's Sociotropy-Autonomy framework, as well as to identify predictors of sociotropic and autonomous tendencies. We sought to explain how neurobiologically grounded personality traits may express themselves as distinct patterns of social engagement and self-reliance. The secondary goal of the study was to identify data clusters based on temperament traits and psychological orientation toward sociotropy or autonomy using K-Means Clustering analysis.

Research Questions and Hypotheses

- Q1: What is the relationship between temperament dimensions and sociotropy?

- Q2: What is the relationship between temperament dimensions and autonomy?

- Q3: Which temperament dimensions predict sociotropy?

- Q4: Which temperament dimensions predict autonomy?

- Q5: Do individuals cluster into distinct subgroups based on their temperament dimensions and their levels of sociotropy and autonomy?

- H1: It is hypothesized that women will score higher in sociotropy than men (Charanya & Simon, 2024).

- H2: It is hypothesized that men will score higher in autonomy than women (Charanya & Simon, 2024).

METHOD

Participants

The subjects of the research were full-time university students (>18 years) from the Pan-European University, Faculty of Psychology (Bratislava, Slovakia). A total of 180 students participated in the research, and the final sample consisted of 161 participants: 80.7% female (N = 130) and 19.3% male (N = 31). The mean age was 20.27 years (SD = 1.25, minimum 18 and maximum 24 years).

Procedure

Data were collected online via the Google Forms platform between October 17, 2024, and December 12, 2024, on university premises with the presence of the research team. We used a convenience sampling method, recruiting students based on their availability and willingness to participate in the study. The research was fully anonymous and voluntary. Data collection relied solely on self-report methods. We translated the Sociotropy-Autonomy Scale from English into Slovak. Back-translation was conducted, and we pilot-tested the translated questionnaires on a small sample to verify comprehensibility. Problematic items were revised and retested on a small sample. Prior to actual data collection, we analyzed the research sample size using the G*Power tool (Faul et al., 2009). The minimum sample size was set at 138 participants to detect medium-sized effects with 95% power (1-β) and an alpha level of 0.05.

Instruments

Temperament was assessed with the *Fisher Temperament Inventory (FTI)*, a 56-item self-report scale that contains 14 items in each dimension. Participants respond to items on a 4-point Likert scale. The FTI measures four separate temperament dimensions related to neurobiological and hormonal correlates of behavior: (1) the dopamine and norepinephrine system (Explorers), (2) the serotonin system (Builders), (3) the testosterone system (Directors), and (4) the estrogen-oxytocin system (Negotiators). In our research, the FTI questionnaire achieved the following reliability values: Explorers, α = .83; Builders, α = .73; Directors, α = .80; Negotiators, α = .80.

Sociotropy-Autonomy Scale (SAS) was developed by Aaron Beck (Beck et al., 1983) to measure two personality dimensions. The questionnaire contains 60 items divided into two subscales: 30 items measuring sociotropy and 30 items measuring autonomy. Participants respond on a percentage-based Likert scale ranging from 0% (never applies) to 100% (always applies). Bieling et al. (2000) reported good internal consistency for both subscales: Sociotropy α = .90 and Autonomy α = .83. In our research, the SAS achieved good reliability values: Sociotropy, α =0.90; Autonomy, α =0.79.

Data Analysis

Data were analyzed using SPSS and JASP statistical software. Frequency analyses were conducted for all variables to examine participants' response patterns. Internal consistency was assessed using Cronbach's alpha coefficient for all instruments. The Shapiro-Wilk test was used to evaluate normality of data distribution. Descriptive statistics including means, medians, standard deviations, ranges, skewness, and kurtosis were calculated for all variables. Bivariate relationships were examined using Pearson correlation coefficient and cluster analysis was performed with the K-Means analysis using the Hartigan-Wong algorithm and silhouette cluster determination. Independent samples t-tests were conducted to assess sex differences in study variables. Effect sizes for group comparisons were calculated using Cohen's d, with values interpreted according to established conventions: small effect (d = 0.20), medium effect (d = 0.50), and large effect (d = 0.80).

Research Ethics

The study was approved by the Department of General Psychology, Faculty of Psychology at Pan-European University. All participants provided written informed consent prior to participation. The survey was completely anonymous and voluntary, and participants were treated in accordance with principles outlined in the Code of Ethics of the Pan-European University. Participants' privacy was

fully protected in compliance with national data protection laws (GDPR).

RESULTS

Descriptive Statistics and Internal Consistency

The mean scores for FTI temperament dimensions (Explorer, Builder, Director, and Negotiator) ranged from M = 23.15 to M = 29.21, with standard deviations ranging from SD = 4.47 to SD = 6.12. Observed scores ranged from 8 to 41 across all dimensions. All variables demonstrated approximately normal distributions based on skewness and kurtosis coefficients. Internal consistency was acceptable across all dimensions, with Cronbach's alpha coefficients ranging from α = .73 (Builder) to α = .83 (Director). Outlier analysis revealed one outlier in the Builder dimension (low score) and one outlier in the Director dimension (high score), while Explorer and Negotiator dimensions contained no outliers.

Normality of data distribution was assessed using the Shapiro-Wilk test. All temperament dimensions demonstrated normal distributions: Explorer (p = .694), Builder (p = .155), Director (p = .107), and Negotiator (p = .094). The Builder dimension showed slight leptokurtosis (kurtosis = 0.71), the Director dimension was slightly positively skewed (skewness = 0.32), and the Negotiator dimension exhibited slight platykurtosis (kurtosis = -0.51).

	Explorer	Builder	Director	Negotiator
Mean	23.31	26.91	29.15	29.21
Median	23.00	27.00	23.00	29.00
SD	6.12	4.47	5.55	5.44
Skewness	0.07	-0.08	0.32	0.01
Kurtosis	-0.03	0.71	0.14	-0.51
Minimum	8.00	10.00	10.00	16.00
Maximum	40.00	39.00	40.00	41.00
Cronbach alfa	0.83	0.73	0.80	0.80

For male participants, mean scores across temperament dimensions ranged from M = 23.74 to M = 26.19 (SD = 4.84 to 6.05), with observed scores ranging from 10 to 38. For female participants, mean scores ranged from M = 22.43 to M = 29.96 (SD = 4.35 to 6.19), with observed scores ranging from 8 to 41.

Table 2. Descriptive Statistics for FTI scales according to sex

	Explorer	Builder	Director	Negotiator	Explorer	Builder	Director	Negotiator
	Men				Women			
Mean	23.74	25.67	26.19	26.03	23.21	27.20	22.43	29.96
Median	23.00	26.00	27.00	25.00	23.00	27.00	22.00	30.00
SD	5.91	4.84	5.79	6.05	6.19	4.35	5.26	5.03
Skewness	0.32	-1.00	-0.46	0.51	0.03	0.23	0.48	0.07
Kurtosis	-0.35	2.07	-0.006	-0.34	0.03	-0.02	0.79	-0.48
Minimum	12.00	10.00	12.00	16.00	8.00	16.00	10.00	18.00
Maximum	36.00	33.00	36.00	38.00	40.00	39.00	40.00	41.00

Independent samples t-tests revealed statistically significant sex differences in the Director and Negotiator dimensions (both p < .001), but not in the Explorer (p = .669) or Builder (p = .087) dimensions. Effect sizes indicated medium to large differences for Director (d = 0.701) and Negotiator (d = -0.752) dimensions.

Table 3. Sex differences in FTI scales

	t	df	Sig. (2-s)	Cohen's D
Explorer	0.429	159	0.669	0.086
Builder	-1.72	159	0.087	-0.344
Director	3.505	159	<0.001	0.701
Negotiator	-3.76	159	<0.001	-0.752

For Sociotropy, the mean score was M=69.44 (SD=18.76), with an empirical range from 20 to 112. For Autonomy, the mean was M=75.83 (SD=12.26), with scores ranging from 40 to 107. Internal consistency, assessed via Cronbach's alpha, indicated good reliability for both dimensions: Sociotropy (α=0.90) and Autonomy (α=0.79). No outliers were detected in the Sociotropy dimension. However, one outlier was identified in the Autonomy dimension, indicating a participant who scored lower than the rest of the sample.

Shapiro-Wilk tests indicated that both Sociotropy (p=0.270) and Autonomy (p=0.486) dimensions exhibited normal distributions. The Sociotropy data were platykurtic (Kurt=−0.59) and slightly negatively skewed (Skw=−0.12), while the Autonomy data were positively skewed (Skw=0.15). Further details regarding these variables are presented in Table 4.

Table 4. Descriptive statistics for SA scales according to sex

| | Men | | Women | |
	Sociotropy	Autonomy	Sociotropy	Autonomy
Mean	58.54	76.93	72.03	75.56
Median	60.00	76.00	73.00	75.00
SD	17.64	10.96	18.14	12.68
Skewness	-0.16	0.09	-0.11	0.17
Kurtosis	-0.58	-0.58	-0.71	0.04
Minimum	20.00	55.00	29.00	40.00
Maximum	89.00	98.00	112.00	107.00

For men, the average score for Sociotropy was M = 58.54, and for Autonomy, it was M = 76.93. The standard deviation recorded for Sociotropy was SD = 17.64, and for Autonomy, it was SD = 10.96. For women, the average score for Sociotropy was M = 72.03, and for Autonomy, it was M = 75.56. The standard deviation recorded for Sociotropy was SD = 18.14, and for Autonomy, it was SD = 12.58. Based on the comparison of means, we found that women did not show a significantly different score between the Sociotropy (M = 72.03) and Autonomy (M = 75.65) dimensions. In contrast, men scored notably lower in the Sociotropy dimension (M = 58.54) compared to their Autonomy score (M = 76.93).

A statistically significant difference was found in the Sociotropy dimension (Table 5). No statistically significant differences were observed in the Autonomy dimension (p = .579). The effect size, expressed using Cohen's *D*, indicates that the sex differences in the Sociotropy dimension (d = -0.747) have a large effect.

Table 5. Sex differences for SA scales

	t	df	Sig. (2-s)	Cohen's *D*
Sociotropy	-3.739	159	<.001	-0.747
Autonomy	0.556	159	0.579	0.111

Relationships Between Variables

The results of the Pearson correlation indicate several significant relationships between the studied dimensions. The strongest correlation was found between the Negotiator and Sociotropy (r = .483; p < .001), followed by Director and Sociotropy (r = -.358; p < .001), Director and Autonomy (r = .344; p < .001), Explorer and Autonomy (r = .272; p < .001) and Explorer and Sociotropy (r = - .208; p < .001).

Table 6. Correlation matrix for FTI and SA scales (Pearson correlations)

		Builder	Director	Negotiator	Sociotropy	Autonomy
Explorer	Pearson	-.083	.350**	-.042	-.208**	.272**
Builder	Pearson		.103	.099	.119	.058
Director	Pearson			-.317**	-.358**	.344**
Negotiator	Pearson				.483**	- .11
Sociotropy	Pearson					-.176*

**. p< 0.01 *p< 0.05

Predictors of Autonomy and Sociotropy

We also aimed to determine whether personality dimensions may act as significant predictors of Autonomy and Sociotropy. We performed a linear regression analysis using the stepwise method, which indicated that Director personality significantly predicted Autonomy (F(1, 160) = 21.294, p < .001), accounting for 11.3% of its variance. Model 2 (Table 7) represented by both Director and Explorer personality predicted 13.3% of the variance in Autonomy (F(2, 159) = 13.296, p < .001).

Table 7. Regression models with Autonomy as dependent variable

Model	Predictor	Adjusted R²	SE	Beta	t	p
1	Director	0.113	0.164	0.344	4.615	< .001
2	Director	0.133	0.173	0.284	3.609	< .001
	Explorer		0.157	0.172	2.189	0.030

To test the predictors of Sociotropy, we conducted a linear regression analysis using the stepwise method. Results indicated that Negotiator personality significantly predicted Sociotropy ($F_{(1, 160)} = 48.320$, $p < .001$), accounting for 22.8% of its variance. Model 2 represented by both Negotiator and Director (inverse, Beta = -0.228), predicted 27.1% of the variance in Sociotropy ($F_{(2, 159)} = 30.685$, $p < .001$).

Table 8. Regression models with Sociotropy as dependent variable

Model	Predictor	Adjusted R²	SE	Beta	t	p
1	Negotiator	0.228	0.239	0.483	6.951	< .001
2	Negotiator	0.271	0.245	0.411	5.768	< .001
	Director		0.240	- 0.228	-3.200	0.002

Cluster Analysis

We also aimed to identify data clusters based on temperament traits and psychological orientation toward Sociotropy or Autonomy. The K-Means Clustering analysis using the Hartigan-Wong algorithm and silhouette cluster determination identified two distinct clusters from a sample of 161 participants. The 2-cluster solution was selected as optimal based on the BIC criterion (809.350). The model explains about 22% of the variance ($R^2 = 0.22$), with a moderate silhouette score of 0.190. The relatively balanced cluster sizes (71 vs 90 participants) suggest meaningful population splits rather than outlier detection.

Table 9. Cluster profiles

Cluster	1	2
Size	71	90
Explained proportion within-cluster heterogeneity	0.404	0.596
Within sum of squares	302.209	446.161
Silhouette score	0.220	0.164
Explorer	-0.459	0.362
Builder	0.035	-0.028
Director	-0.677	0.534
Negotiator	0.483	-0.381
Sociotropy	0.684	-0.540
Autonomy	-0.543	0.428

Cluster 1 is represented by 71 participants (44% of sample) and is characterized by high Negotiator scores, low Explorer and Director temperament traits, low Autonomy, and high Sociotropy.

Cluster 2 is represented by 90 participants (56% of sample) and is characterized by high levels of Director temperament traits, high Autonomy, and moderate Explorer traits along with low Sociotropy and low Negotiator traits.

Table 10. Model Performance Metrics

	Value
Maximum diameter	7.163
Minimum separation	0.712
Pearson's γ	0.334
Dunn index	0.099
Entropy	0.686
Calinski-Harabasz index	44.963

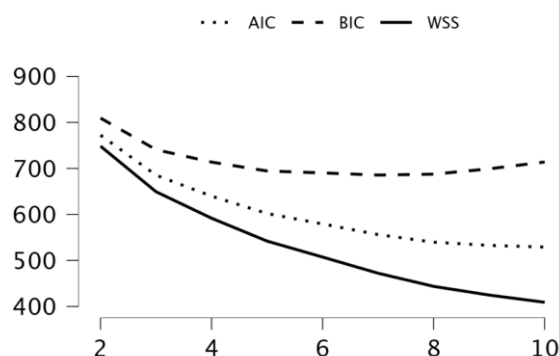Note. All metrics are based on the euclidean distance.
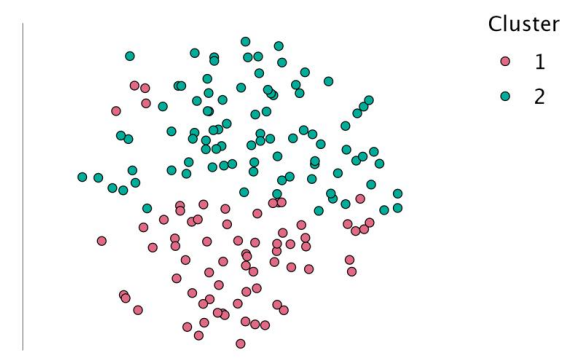

Figure 1. Elbow Method Plot

Figure 2. t-SNE Cluster Plot

DISCUSSION

Contemporary personality research increasingly emphasizes the integration of biological and psychological frameworks to understand human behavior. Fisher's temperament model provides a neurobiologically-based approach to personality, identifying four temperament dimensions rooted in distinct neurochemical pathways (Fisher, 2009; Fisher

et al., 2012; Brown et al., 2015). Complementing this biological perspective, Beck's Sociotropy-Autonomy framework examines how individuals differ in their relational versus independence-oriented psychological tendencies (Beck et al., 1983; Bieling et al., 2000). The present research explored connections between these two theoretical models, examining whether neurobiologically-grounded temperament traits predict patterns of sociotropy and autonomy.

Our investigation revealed several significant associations. The strongest relationship emerged between the Negotiator dimension (estrogen-oxytocin) and Sociotropy, indicating that individuals characterized by elevated levels of empathy, enhanced capacity for interpersonal understanding, and a pronounced orientation toward relational harmony (Fisher et al., 2015) demonstrate correspondingly heightened social orientation tendencies (Beck, 1983). This finding aligns with research by Exline et al. (2012), who discovered that sociotropic individuals exhibit predisposition toward maintaining interpersonal harmony and securing social approval, characteristics that parallel the defining features of agreeableness.

The neurobiological foundation underlying the Negotiator temperament provides additional insight into these behavioral patterns. According to Fisher (2009), estrogen and oxytocin are the leading neurochemicals in the Prosocial/Empathic (Negotiator) personality type. Estrogens regulate not only female reproductive physiology but also a variety of nonreproductive behaviors including mood, cognition, sensomotor integration, and energy homeostasis (Nelson, 2011). Estrogen significantly affects the dopaminergic, serotonergic, and cholinergic systems - brain regions crucial to higher cognitive function and mood regulation (Nelson, 2011; Hildebrandt et al., 2010; Kendrick, 2000; Kovatsi & Nikolaou, 2019).

Oxytocin functions as both a neurohormone and neurotransmitter, actively involved in complex emotional and social behaviors, memory, and learning processes (Kovatsi & Nikolaou, 2019). Research demonstrates that oxytocin administration in humans decreases cortisol release and relieves anxiety, with this anxiolytic effect potentially enabling the development of complex emotional and social behaviors essential for relationship formation, including social recognition, social approach, trust, attachment, affiliation, and bonding (Kovatsi & Nikolaou, 2019). Neuroimaging studies show that oxytocin reduces amygdala activation, thus reducing anxiety and enabling trust (Snowdon, 2011). Physical contact behaviors such as grooming, touch, and sexual behavior stimulate oxytocin production, which enables the formation and strengthening of social relationships (Snowdon, 2011).

The close relationship between estrogen and oxytocin is particularly relevant, as oxytocin synthesis, storage, and receptor expression are influenced by estrogen (Kendrick, 2000). According to Fisher and colleagues, these neural pathways produce numerous similar behavioral effects and are probably closely related (Fisher et al., 2010). This neurochemical synergy may explain why estrogen-oxytocin-mediated emotional sensitivity and interpersonal focus can simultaneously enhance empathic connection while potentially increasing vulnerability to psychological distress in highly sociotropic individuals.

Furthermore, the Negotiator dimension demonstrated significant associations with various psychopathological manifestations, as assessed through the Symptom Checklist-90. Specifically, this temperament dimension exhibited associations with anxiety, depression, psychoticism, obsessive-compulsive tendencies, and interpersonal sensitivity. The Negotiator temperament emerged as a strong predictor of both anxiety and depressive symptomatology within this study (Klanduchová & Vozárová, 2025), suggesting a potential vulnerability pathway linking empathic sensitivity to psychological distress.

These findings are consistent with established research data, particularly those documenting a strong relationship between the Negotiator temperament, neuroticism (Fisher et al., 2015; Klanduchová, 2023) and psychological distress (Klanduchová & Vozárová, 2025). This convergence of evidence is further substantiated by empirical investigations revealing positive associations between neuroticism and sociotropic tendencies (Moore & Blackburn,1994; Perkovic & Pechenkov, 2023).

A significant relationship was identified between the Director temperament and Autonomy, demonstrating that individuals exhibiting testosterone-driven personality traits manifest higher levels of autonomous

functioning. These individuals demonstrate a preference for assuming command and formulating decisions based upon their independent judgment, rather than seeking or depending upon external validation or social support systems.

According to Fisher (2009), the Director personality type (Analytical/Tough-Minded dimension of the Fisher Temperament Inventory) is associated with testosterone and characterized by traits including emotional containment, analytical thinking, boldness, dominance, self-confidence, logical reasoning, competitiveness, decisiveness, and enhanced spatial skills.

The underlying neurobiological mechanisms provide additional insight into these behavioral patterns. Testosterone, a steroid hormone produced primarily by testes and ovaries, plays a crucial role in brain development, reproductive physiology, and social behavior (Schaal, Tremblay, Soussignan, & Susman, 1996; Booth et al., 2006). Research demonstrates that testosterone enhances self-confidence, spatial orientation, competitiveness, and risk-taking behaviors - elements essential for successful survival and reproduction (Dabbs & Dabbs, 2000). These characteristics align closely with the autonomous functioning observed in Directors.

The relationship between testosterone and social behavior is particularly relevant to understanding autonomy. Plasma testosterone correlates with aggressive behavior and social dominance in humans (Ehrenkranz et al., 1974), while higher testosterone levels are associated with assertiveness, dominance, and reduced social sensitivity (Baron-Cohen et al., 2005). Prenatal testosterone expression has been linked to decreased emotion recognition, reduced eye contact, and diminished empathy (Baron-Cohen, 1995), suggesting that testosterone-mediated traits may facilitate independent functioning by reducing dependence on social cues and emotional validation.

Furthermore, testosterone shows positive correlations with antisocial personality traits and criminal thinking patterns in both men and women (Tajima-Pozo et al., 2015). In normal populations, testosterone is strongly associated with sensation seeking, extraversion, dominance, and assertiveness (Zuckerman, 1995). This neurochemical profile supports the observed association between Director temperament and autonomous functioning, as testosterone-driven individuals appear biologically predisposed toward independent decision-making and self-reliant behavioral patterns.

As predicted, we observed a significant inverse association between the Director temperament and Sociotropy, indicating that individuals with testosterone-driven temperament exhibit limited orientation toward interpersonal needs satisfaction and social approval-seeking behaviors. This pattern suggests that Directors exhibit reduced dependency on external validation and demonstrate less preoccupation with maintaining social harmony or accommodating others' expectations.

Empirical investigations have consistently documented a negative relationship between the Director dimension and agreeableness (Fisher et al., 2015; Klanduchová, 2023), while concurrent research has established that agreeableness maintains an inverse relationship with autonomous tendencies (Beck et al., 1983; Bieling et al., 2000; Perkovic & Pechenkov, 2023). These findings demonstrate remarkable consistency with established research paradigms, particularly those documented by Fisher et al. (2015) and Perkovic & Pechenkov (2023), thereby providing convergent empirical support for the theoretical proposition that testosterone-mediated personality characteristics fundamentally predispose individuals toward interpersonal independence and reduced prosociality and social conformity tendencies.

A statistically significant negative association was identified between the Explorer temperament dimension and Sociotropy, suggesting that individuals characterized by adventurous dispositions and novelty-seeking behaviors demonstrate diminished sociotropic tendencies, thereby indicating a reduced orientation toward interpersonal relationships and decreased reliance on social acceptance for psychological well-being. Conversely, a significant positive correlation was found between the Explorer temperament dimension and Autonomy, suggesting that individuals who are curious, open to new experiences, and enjoy discovering new things tend to forge their own path and do not have a strong need to rely on others.

This finding demonstrates theoretical coherence with established research documenting a robust positive

correlation between the Explorer dimension and extraversion (Fisher et al., 2015; Klanduchová, 2023), coupled with empirical evidence revealing a negative association between extraversion and sociotropic orientation (Perkovic & Pechenkov, 2023).

The neurobiological foundation underlying the Explorer temperament provides additional insight into these behavioral patterns, as this dimension is primarily governed by the dopamine-norepinephrine neurotransmitter system (Fisher, 2009). This neurochemical architecture is intrinsically linked to sensation-seeking behaviors, heightened enthusiasm, increased susceptibility to boredom, and behavioral disinhibition (Zuckerman, 2005). Individuals exhibiting Explorer characteristics demonstrate an inherent drive toward novel stimuli and experiential diversity, manifesting traits including elevated curiosity, high energy levels, intrinsic motivation, optimism, adaptability, intellectual flexibility, and prosocial generosity. However, this temperamental profile may also encompass potentially maladaptive characteristics such as impulsivity, behavioral unpredictability, organizational deficits, and predisposition toward addictive behavioral patterns (Fisher, 2009). This neurochemical basis thus provides a compelling explanatory framework for the observed inverse relationship between exploratory tendencies and social dependency, as well as the positive association with autonomous functioning.

The regression analyses revealed that Director and Explorer personality dimensions collectively accounted for 13.3% of the variance in Autonomy, while the model incorporating Negotiator and Director (inverse relationship) explained 27.1% of the variance in Sociotropy. These findings provide additional empirical support for the theoretical validity of the behavioral tendencies associated with neurohormonal personality profiles, demonstrating meaningful predictive relationships between Fisher's temperament dimensions and Beck's psychological constructs.

Gender differences emerged as a significant factor in our analysis, with large effect sizes observed for both Sociotropy and the Negotiator dimension. Female participants demonstrated significantly higher scores on both constructs compared to male participants, a pattern consistent with our hypotheses (H1 and H2) and supported by previous research (Charanya & Simon,

2024). These findings align with the neurobiological foundation of these constructs. The Negotiator dimension (estrogen-oxytocin) shows predictable sex differences given that estrogenes play a crucial role in modulating social cognition, empathy, and relationship-oriented behaviors in women (Nelson, 2011). Similarly, the elevated Sociotropy scores among females reflect well-documented gender differences in interpersonal orientation and social connectedness (Beck et al., 1983; Moore & Blackburn, 1994). The magnitude of these effects underscores the importance of considering biological sex as a fundamental variable when examining personality constructs rooted in sex-differentiated neurochemical systems. However, it is important to note that while our sample revealed these patterns, the substantial gender imbalance (80.7% female) necessitates cautious interpretation and suggests the need for replication with more balanced samples.

To further explore the relationships between Fisher's temperament dimensions and Beck's psychological constructs, we conducted K-means clustering analysis to identify distinct personality profiles within our sample. The analysis, employing the Hartigan-Wong algorithm with silhouette cluster determination, revealed two meaningful personality clusters among the 161 participants. The optimal 2-cluster solution explained 22% of the variance, with relatively balanced cluster sizes indicating genuine population heterogeneity. The clustering results illuminate two fundamentally distinct personality orientations that align with theoretical predictions. Cluster 1 (N = 71, 44% of sample) represents a "Sociotropic Negotiator profile" characterized by substantially reduced Director traits (-0.677), significantly lower Explorer scores (-0.459), and diminished Autonomy (-0.543). Conversely, these individuals demonstrated heightened Sociotropy (0.684) and elevated Negotiator scores (0.483), reflecting a preference for social harmony, collaborative approaches, and interdependent functioning. The higher silhouette score for this cluster suggests greater internal cohesion among relationship-oriented individuals.

The neurobiological profile underlying this cluster suggests a combination of low testosterone, low dopamine, and elevated estrogen-oxytocin activity. The markedly reduced Director scores align with lower

testosterone levels, which would manifest as decreased dominance, reduced competitiveness, and diminished assertiveness - characteristics typically associated with testosterone-driven behavior. Similarly, the significantly lower Explorer scores correspond to reduced dopamine activity, resulting in decreased novelty-seeking, lower risk-taking propensity, and reduced motivation for exploratory behaviors. In contrast, the elevated Negotiator scores indicate heightened estrogen-oxytocin functioning, promoting enhanced empathy, stronger prosocial orientation, increased emotional expressivity, and superior capacity for interpersonal connection and social bonding. This neurochemical constellation creates individuals who are naturally predisposed toward relationship harmony, social approval-seeking, and collaborative problem-solving approaches, while showing reduced inclination toward independent action or leadership roles.

Cluster 2 (N = 90, 56% of sample) exhibits an "Autonomous Director/Explorer profile" distinguished by substantially elevated Director traits (0.534) and higher Explorer scores (0.362) and increased Autonomy (0.428). These participants showed low Sociotropy (-0.540) and reduced Negotiator scores (-0.381), indicating preferences for independent decision-making, leadership roles, and self-reliant functioning. The lower silhouette score suggests greater internal variability within this autonomy-oriented cluster.

These findings provide compelling evidence for the existence of distinct personality phenotypes that link neurobiological temperament and psychological orientation. The clear directional differences across multiple personality dimensions, combined with balanced cluster sizes, suggest these represent meaningful personality types. The clustering pattern supports the theoretical integration of Fisher's temperament model with Beck's sociotropy-autonomy framework, demonstrating that individuals naturally segregate into relationship-focused versus independence-oriented psychological profiles.

Limitations

The sample's demographic profile and age range limit generalizability. A critical limitation of this study concerns the substantial gender imbalance in our sample, with females representing 80.7% of participants compared to only 19.3% males. While this distribution reflects the typical demographic composition of psychology student populations, it significantly constrains the generalizability of our findings. The large effect sizes observed for Sociotropy and the Negotiator dimension may be disproportionately influenced by the predominantly female sample, potentially limiting our ability to draw robust conclusions about these constructs in males. Future research should prioritize recruiting gender-balanced samples to enable more definitive conclusions about sex differences in the relationships between Fisher's temperament dimensions and sociotropy-autonomy orientations. Furthermore, the length of the questionnaires may have impacted participants' focus and accuracy in their responses. Finally, the use of self-report scales introduces various biases, including social desirability and subjective interpretation.

Conclusion

This research bridged biological and psychological approaches to personality, providing additional empirical evidence that individual neurobiological makeup translates into observable patterns of social behavior and psychological functioning. These findings support the theoretical validity of using neurobiological markers to predict psychological tendencies, advancing the field's ability to understand personality through an integrated biopsychological lens. The integration of neurobiological temperament traits and psychological orientation also offers practical applications across multiple domains. In clinical settings, therapists can personalize treatment approaches by using temperament assessment to match interventions with individual neurohormonal profiles. Individuals with high Negotiator scores may benefit from approaches addressing interpersonal sensitivity, dependency, and anxiety management, while those with high Director scores might respond better to cognitive-behavioral techniques emphasizing logical and structured problem-solving. Workplace applications include optimizing team composition by combining Sociotropic Negotiators who excel in collaborative, harmony-focused roles with Autonomous Directors who naturally gravitate toward leadership and independent decision-making. This understanding can inform conflict resolution strategies, leadership development

programs, and career counseling by matching individuals with roles that align with their natural temperamental predispositions. Personal development applications include relationship coaching and counseling that help individuals understand their behavioral patterns along the sociotropic-autonomic spectrum, enabling more effective communication and conflict resolution. The cluster analysis revealing distinct personality phenotypes can guide targeted stress management strategies, with Negotiators benefiting from social support systems while Directors would benefit from enhancing their individual coping skills.

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