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## SOCIAL PSYCHOLOGY

# Climate Change Worry in Italian Young Adults: Psychosocial Predictors and Differences by Level of Environmental Activism Engagement

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**Background.** Climate change worry is an increasingly relevant emotional response among young adults. However, less is known about the psychosocial predictors of climate change worry and whether these associations differ by level of environmental activism engagement.

**Objective.** This study examined psychosocial predictors of climate change worry in Italian young adults, focusing on mental health, personality traits, perceived individual and social norms, and individual and collective climate self-efficacy. A secondary aim compared more engaged versus less engaged participants.

**Method.** Using convenience and snowball sampling via social media and word of mouth, 302 Italian young adults aged 18–35 years ( $M=24.20$ ,  $SD=3.73$ ; 62% female) completed an online survey. Group differences were tested using one-way ANOVAs. Multiple regression analyses were conducted separately in the more engaged ( $EA_{MORE}$ ) and less engaged ( $EA_{LESS}$ ) groups to identify predictors of climate change worry.

**Results.**  $EA_{MORE}$  reported significantly higher climate change worry than  $EA_{LESS}$ . In  $EA_{MORE}$ , climate change worry was predicted by mental health, collective self-efficacy, and perceived individual and social norms. In  $EA_{LESS}$ , climate change worry was predicted by mental health and perceived individual and social norms, whereas collective self-efficacy was not significant.

**Conclusion.** Climate change worry appears to reflect a combination of well-being and normative/efficacy-related processes, with different patterns depending upon the level of activism engagement. Supporting effective coping strategies may help reduce the emotional burden associated with sustained engagement.

**Keywords:** climate worry, youth, environmental activism, self-efficacy, well-being, Italy

## Introduction

Climate change and related environmental crises have proven to be not only environmental and socio-economic challenges, but also profound psychological stressors (Parmentier et al., 2024). As part of the growing number of psychological responses to environmental change, climate change worry (or eco-worry) has gained increased attention (Orrù et al., 2024). Climate change worry can be defined as a persistent form of concern or fear about environmental degradation and its current or future effects on ecosystems, human health and societal stability. As the literature analysis by Soutar and Wand (2022) shows, climate change worry is a component of eco-anxiety. The latter term was used by Clayton and Karazsia (2020) to describe a relatively intense form of anxiety, as opposed to a milder concern that can occur even without direct contact with the effects of climate change. However, as Pihkala (2020) suggests, it is important to avoid pathologizing experiences related to climate change perceptions. Anxiety can manifest along a spectrum of emotions that can range from mild to severe. The danger is to trivialize a term associated with a pathological manifestation that requires diagnosis and clinical intervention (Ojala et al., 2021; Bulbena-Vilarrasa & Bulbena-Cabré, 2024). In its severe form, anxiety may lead to panic attacks, obsessive thinking, appetite changes, and insomnia. These symptoms can significantly interfere with daily functioning (Léger-Goodes et al., 2022). Therefore, the term ‘eco-anxiety’ may not be the most appropriate to describe the negative feelings associated with climate change. Several scholars suggest that the term climate change worry is often more appropriate than eco-anxiety (see *e.g.* Ojala, 2012, 2019; Pihkala, 2020; Kurt & Akdur, 2024). Climate change worry can be considered an adaptive process, as it may motivate individuals to seek strategies for coping with environmental consequences (Innocenti et al., 2022; Cianconi et al., 2023). However, whether such concern is truly adaptive depends on its intensity and whether it triggers excessive negative emotions. Recent studies suggest that climate change worry is a multifaceted phenomenon. It may serve as a motivator for pro-environmental behavior, but it can also contribute to psychological stress, hopelessness, or maladaptive coping (Vecina et al., 2025). Understanding climate change worry is therefore crucial, both for mental health and as a potential driver for constructive engagement with environmental issues. Despite its relevance, empirical research on climate change worry remains relatively limited, and debates continue about its conceptual limitations, its measurement and its impact on well-being and behavior (López-García et al., 2025). Given the relevance of climate change worry for mental health and behavior, it is particularly important to examine how this phenomenon manifests among specific population groups.

As suggested by Ojala and Bengtsson (2019), young adults are the group most affected by the climate change narrative, probably because they will have to deal with it in the coming years and decades; they are also part of the climate change problem because of their lifestyle, as they are the consumers and citizens of today. There are personality traits that are vulnerability factors for climate worry, such as difficulty tolerating uncertainty (Taylor, 2020), negative emotionality (neuroticism; in particular in young people, see Ogunbode et al., 2024), tendency to overestimate threats, and sensitivity to fear (Tucholska et al., 2024).

Beyond socio-demographic exposure, previous research has suggested that individual differences may shape how climate change worry is experienced. Two basic individual characteristics (personal characteristics and mental health) and two individual dimensions specifically related to climate issues (individual and collective climate self-efficacy and perceived individual and social norms related to climate change) are considered. Mental health is considered in the present study as a general psychological condition that may influence individuals' vulnerability to climate-related worry, rather than as an outcome of such worry. The theoretical framework into which the study fits is the Theory of Planned Behavior (TPB), a model developed by Ajzen (1991) that assumes that behavior is influenced by intention, which is shaped by attitudes, subjective norms and perceived behavioral control. In the present study, the TPB is used as a conceptual framework to justify the inclusion of norms and perceived behavioral control as psychosocial factors that may shape emotional responses to climate change, rather than behavior per se. In some studies (e.g. Fielding et al., 2008; Jew & Tran, 2022), the theory has been used to understand the intentionality of engagement in activism. More recently, Abonyi and McDermott (2024) conducted a study with 142 subjects in the UK and Hungary and highlighted that joining an environmental organization is associated with negative feelings and that belief in the ability to take action on climate change predicts all aspects of activism. Innocenti et al. (2023) suggested that individuals who perceive their own behavior, as well as others' behavior, as effective in improving environmental health are more likely to adhere to pro-environmental norms. This adherence may translate into various forms of pro-environmental behavior, including activism. Bandura's (1982) theory of self-efficacy can be summarized as the belief that one has the necessary resources and skills to perform or complete a particular task. The feeling of self-efficacy reflects people's confidence that they can perform a behavior if they want to (Bain & Bongiorno, 2020). Self-efficacy has been shown to be a strong predictor of intention to act. In the case of environmentalists, self-efficacy is the belief that one has valuable skills to contribute to the achievement of group goals (Lenart-Gansiniec et al., 2022). When a group believes in its collective ability to learn, solve problems, or bring about change, its members are more likely to support one another (Vygostky, 1926, cited in Ratner, 1991). This process can foster engagement in collective environmental actions, such as participation in protest initiatives.

In addition to social and motivational factors, previous research has also examined the role of stable individual characteristics, such as personality traits, in shaping pro-environmental concern and behavior. Furthermore, the study conducted by Tucholska et al. (2024) with 333 participants in Poland showed that pro-environmental behavior is related to openness, a personality trait. Personality is defined as a characteristic and relatively stable pattern of thoughts, feelings and behaviors exhibited by individuals and provides an important explanation for individual differences in pro-environmental behavior. A meta-analysis based on 38 data sets of almost 50.000 people examined the relationships between the central personality dimensions of the Big Five model and showed the strongest correlations between openness, agreeableness, conscientiousness and - albeit to a lesser extent - extraversion with pro-environmental behavior. These results were later confirmed by Soutter and Möttus (2021), who

found the strongest correlations between openness and pro-environmental behavior, followed by agreeableness and conscientiousness. At the same time, extraversion and neuroticism showed low correlations with pro-environmental behavior.

Overall, openness proves to be the most influential personality trait in the expression of pro-environmental behavior. This trait is associated with abstract and flexible thinking, which enables individuals to grasp the complex temporal and spatial consequences of the climate crisis. In addition, openness can indirectly promote activism by influencing the values that individuals hold.

In this study, climate change worry is conceptualized as a psychological outcome whose level may vary as a function of individual, social, and motivational factors. Accordingly, the study adopts a predictor-oriented approach, focusing on the psychosocial factors associated with different levels of climate change worry. The main objective of this study was to compare climate change worry in two groups of young adults living in Italy, based on their engagement in environmental activism. In Italy, a survey from 2019 found that more than half of a sample of 800 young adults cited climate change as the main cause of stress (SWG, 2019), while the ISTAT report (2025) shows that 116.628 young adults are engaged in environmental volunteerism. The two groups were compared with respect to several personal variables. These included personality traits and mental health, as well as climate-related dimensions such as individual and collective self-efficacy and perceived individual and social norms. The second aim of the study was to analyze the relationship between the above-mentioned personal variables and climate change worry, separately for participants that are “more” ( $EA_{\text{MORE}}$ ) or “less” ( $EA_{\text{LESS}}$ ) engaged in environmental activism.

Based on the above-mentioned literature, we hypothesised that  $EA_{\text{MORE}}$  perceive higher climate change worry than  $EA_{\text{LESS}}$  (*Hp. 1*) and that they are characterized by openness, agreeableness and conscientiousness (*Hp. 2a*). At the same time, we hypothesised that  $EA_{\text{LESS}}$  — more than  $EA_{\text{MORE}}$  — are characterized by extraversion and neuroticism (*Hp. 2b*). We also hypothesised that  $EA_{\text{MORE}}$  perceive a better mental health status (*Hp. 3*), a higher level of individual and collective self-efficacy (*Hp. 4*) and a higher level of individual and social norms (*Hp. 5*) than  $EA_{\text{LESS}}$ . *Hypothesis 3* was formulated as theoretically exploratory, as previous research has provided mixed findings on the association between environmental activism and mental health, and no clear directional expectation has been consistently established.

## Methods

Based on this conceptual framework, climate change worry was examined as an outcome variable, while personality traits, mental health, perceived norms, and climate self-efficacy were included as psychosocial predictors.

### *Participants*

A total of 308 young adults living in Italy participated in the study by completing an anonymous online questionnaire. Of the participants, 30% identified as male, 62% as female, and 8% preferred not to report their gender. Participants' ages ranged from 18 to 35 years ( $M = 24.20$ ,  $SD = 3.73$ ). Participation was voluntary, and no compensation was provided.

## Measures

Participants completed an anonymous online questionnaire. The instrument was specifically developed for the purposes of the study and administered using the LimeSurvey platform. Convenience and snowball sampling strategies were used.

Environmental Activism was measured through 7 items assessing the engagement of the participants in different activities during the last year. The items were taken from the Environmental Action Scale (EAAS; Alisat & Riemer, 2015). As suggested by Clayton and Parnes (2025), the selected items refer to specific areas: participation in or organization of educational activities; contact with elected officials; raising awareness of climate change on public platforms (*e.g.*, letters to the editor, social media); participation in or organization of protests, rallies, boycotts, and/or petitions; financial support for an environmental or climate-related cause; and engagement (*e.g.*, volunteering, working) or building local coalitions (*e.g.*, “In the past year ... I have volunteered with an environmental organization working on climate issues”). For the purposes of our study, the following answers were possible for each question: yes (*coded as 2*) or no (*coded as 1*). The items were totaled and the mean was calculated ( $M = 9.67$ ;  $SD = 2.18$ ). Participants who scored above the mean value were considered  $EA_{\text{MORE}}$  (meaning that they answered “yes” to at least three of the items).

Climate change worry was measured through a scale consisting of 10 items adapted from the work of Stewart (2021) and the Italian version edited by Innocenti et al. (2022). Participants were asked to indicate the degree of worry about several issues, such as: perceiving to experience a worry about climate change more than other people; having a tendency to worry when hearing about climate change, even when the effects might be far away; believing that bad weather might be a consequence of climate change; difficulty in their ability to stop thinking about climate change. For each question, possible responses were: strongly disagree (*coded as 1*), disagree (*coded as 2*), neither agree nor disagree (*coded as 3*), agree (*coded as 4*), and strongly agree (*coded as 5*). Range: 10–50. Cronbach’s alpha = .88.

Personality Traits were measured through the Brief Big Five Personality Inventory-10 (BFI-10)- (John, Donahue & Kentle, 1991). It consisted of a 10-item scale (developed based on the 44-item Big Five Inventory) measuring the Big Five personality traits: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness (2 items for each personality trait). For each item possible responses were: strongly disagree (*coded as 1*), in disagreement (*coded as 2*), neither agree nor disagree (*coded as 3*), in agreement (*coded as 4*), strongly agree (*coded as 5*). Range of each personality trait: 2–10.

Mental health was assessed through the WHO-5 Mental Health Index: this scale is an abbreviated version of the WHO-10, developed by the World Health Organization (Bech et al., 1996). It consists of 5 items inherent to subjective mental well-being. The WHO-5 has only positive valence expressions, as well-being is considered an expression of good mental health. Participants had to indicate the answer that most closely resembled how they have been feeling for the past two weeks (*for example*, cheerful and in a good mood; calm and relaxed; active and energetic). Possible responses were: never (*coded as 0*), sometimes (*coded as 1*), less than half-time (*coded*

as 2), more than half-time (*coded as 3*), most of the time (*coded as 4*), and always (*coded as 5*). Range: 0–25. Cronbach's  $\alpha = .79$ .

Climate self-efficacy (Individual and Collective) was assessed through the Perceived Climate Self-Efficacy Scale (Doran, Hanss & Larsen, 2015; 2017). Participants were asked to indicate the extent to which they agreed with a series of statements, 5 of which related to individual self-efficacy (*for example*, ability to motivate others to do something for the climate crisis; ability to make an important contribution to climate change mitigation through personal actions) and 5 of which related to collective efficacy (*for example*, belief that young people can contribute to solving the climate crisis; belief that young people can help protect the climate through efforts to influence climate legislation). For each question, possible responses were: strongly disagree (*coded as 1*), disagree (*coded as 2*), neither agree nor disagree (*coded as 3*), agree (*coded as 4*), and strongly agree (*coded as 5*). Range of each scale: 5–25. Cronbach's  $\alpha = .78$  and  $.81$  respectively.

Perceived individual norms related to climate change were measured using 2 items (Doran & Larsen, 2016) aimed to assess participants' perceived concern for the environment as an important part of themselves and their existence as a young person. Possible responses were: strongly disagree (*coded as 1*), disagree (*coded as 2*), neither agree nor disagree (*coded as 3*), agree (*coded as 4*), and strongly agree (*coded as 5*). Range: 2–10. Cronbach's  $\alpha = .76$ .

Perceived social norms related to climate change were measured using 8 items related to worry and fears about climate change and its future impacts (Doran & Larsen, 2016). Participants were asked the extent to which the statements applied to people they care about (*4 items*) and to people of the same age (*4 items*). Possible responses were: strongly disagree (*coded as 1*), disagree (*coded as 2*), neither agree nor disagree (*coded as 3*), agree (*coded as 4*), and strongly agree (*coded as 5*). Range: 8–40. Cronbach's  $\alpha = .84$ .

### ***Procedure and data analysis***

The local ethical committee of the University of Turin approved this research project (protocol code 0421423). The sample was recruited with the help of platforms such as LinkedIn, Instagram\* (specifically contacting *Fridays For Future* pages) and through word of mouth. The data were collected between July and September 2023. The participants completed an anonymous online questionnaire accompanied by an information letter and an informed consent form. The compilation took about 20 minutes.

Data were processed with SPSS version 28 (IBM Corp., Armonk, NY, USA). Reliability of the measures was assessed with Cronbach's  $\alpha$ . One-way ANOVA analyses were used to test group differences between EA<sub>MORE</sub> and EA<sub>LESS</sub> participants, whereas multiple regression analyses were conducted to examine the psychosocial predictors of climate change worry. Eta squared was calculated to estimate effect size.

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\* Activities of Meta Platforms Inc. (Facebook and Instagram), and the X Corp. (as the successor of Twitter Inc.), are prohibited in the Russian Federation.

## Results

### *Descriptive statistics*

Participants were classified as more or less engaged in environmental activism based on their position relative to the sample mean. This criterion was adopted as an operational and distribution-based approach to distinguish higher versus lower levels of engagement, rather than to define discrete activist categories. Accordingly, this grouping should be interpreted as reflecting relative differences in engagement within the sample. Based on the seven items measuring Environmental Activism we divided the sample into two groups (excluding 6 subjects with missing data): EA<sub>MORE</sub> (those who reported being involved in at least three different environmental activism activities; N = 127; 42%) and EA<sub>LESS</sub> (those who reported being involved in less than three different environmental activism activities; N = 175; 58%). The use of a mean-based cut-off allowed the inclusion of participants with intermediate levels of engagement in the analytical comparison, while avoiding overly restrictive categorizations.

The level of climate change worry was compared between the two groups using a one-way ANOVA analysis. To test *Hypothesis 1*, a one-way ANOVA was conducted to compare levels of climate change worry between young adults who were more engaged (EA<sub>MORE</sub>) and less engaged (EA<sub>LESS</sub>) in environmental activism. For results, see *Table 1*.

**Table 1**

*Climate change worry: comparison between EA<sub>MORE</sub> and EA<sub>LESS</sub>*

	EA <sub>MORE</sub> (N=127) M (SD)	EA <sub>LESS</sub> (N=175) M (SD)	F	P	$\eta^2$
Climate change worry	39.00 (6.07)	34.02 (7.33)	38.03	<.001	.114

*Note.* M = mean; SD = standard deviation; F = Fisher's ratio; p = p value;  $\eta^2$  = eta squared.

**Table 2**

*Personality traits and mental health: comparison between EA<sub>MORE</sub> and EA<sub>LESS</sub>*

	EA <sub>MORE</sub> (N=127) M (SD)	EA <sub>LESS</sub> (N=175) M (SD)	F	p	$\eta^2$
Extraversion	6.36 (1.74)	6.22 (1.75)	.513	.475	.002
Agreeableness	6.58 (1.58)	6.27 (1.61)	2.612	.107	.009
Conscientiousness	6.62 (1.50)	6.77 (1.28)	.875	.350	.003
Neuroticism	6.56 (1.85)	6.46 (2.03)	.158	.691	.001
Openness	6.92 (1.59)	7.03 (1.45)	.394	.531	.001
Mental Health	14.74 (4.22)	16.39 (4.06)	11.67	<.001	.038

*Note.* M = mean; SD = standard deviation; F = Fisher's ratio; p = p value;  $\eta^2$  = eta squared.

The results support *Hypothesis 1*, indicating significantly higher levels of climate change worry among EA<sub>MORE</sub>.

To test *Hypotheses 2a, 2b*, and 3, a one-way ANOVA was performed to compare EA<sub>MORE</sub> and EA<sub>LESS</sub> with respect to personality traits and mental health. For results, see *Table 2*.

As we can see from the results shown in *Table 2*, there are no significant differences between EA<sub>MORE</sub> and EA<sub>LESS</sub> with respect to the five personality traits. In contrast, a significantly higher level of mental health is found in EA<sub>LESS</sub>. *Hypotheses 2a* and *2b* were not supported, as no significant differences emerged for personality traits. *Hypothesis 3* was not supported, as EA<sub>LESS</sub> participants reported significantly higher levels of mental health.

Next, variables more specifically related to the issue of climate were examined.

To test *Hypotheses 4* and *5*, a one-way ANOVA was performed to compare EA<sub>MORE</sub> and EA<sub>LESS</sub> on individual and collective climate self-efficacy and perceived individual and social norms related to climate change. For results, see *Table 3*.

**Table 3**

*Individual and collective climate self-efficacy, perceived individual and social norms related to climate change: comparison between EA<sub>MORE</sub> and EA<sub>LESS</sub>*

	EA <sub>MORE</sub> (N=127) M (SD)	EA <sub>LESS</sub> (N=175) M (SD)	F	p	η <sup>2</sup>
Individual self-efficacy	18.35 (3.25)	16.57 (3.75)	17.47	<.001	.057
Collective self-efficacy	19.65 (2.82)	18.09 (3.64)	15.36	<.001	.050
Individual norms	8.22 (1.53)	6.94 (1.62)	46.01	<.001	.136
Social norms	27.61 (4.86)	26.77 (5.28)	1.94	.165	.007

*Note.* M = mean; SD = standard deviation; F = Fisher's ratio; p = p value; η<sup>2</sup> = eta squared.

As we can see in *Table 3*, EA<sub>MORE</sub> show significant higher levels than EA<sub>LESS</sub> in both individual and collective climate self-efficacy and in perceived individual norms related to climate change. No differences were found concerning social norms. *Hypothesis 4* was supported, whereas *Hypothesis 5* was only partially supported.

To find out how climate change worry was related to personality traits, mental health, individual and collective climate self-efficacy, perceived individual and social norms related to climate change in EA<sub>MORE</sub> and EA<sub>LESS</sub>, correlation analyses were performed separately in the two groups. *Table 4* reports the results for EA<sub>MORE</sub> and EA<sub>LESS</sub> respectively.

As reported in *Table 4*, concerning personality traits, we can see that climate change worry is negatively related to agreeableness, and positively related to neuroticism and openness only in EA<sub>MORE</sub>. Moreover, climate change worry is positively related to individual and collective self-efficacy, individual and social norms both in EA<sub>MORE</sub> and EA<sub>LESS</sub>.

**Table 4***Correlations analysis in EA<sub>MORE</sub> and EA<sub>LESS</sub>*

	Climate change worry EA <sub>MORE</sub>	Climate change worry EA <sub>LESS</sub>
Extraversion	-.09	.03
Agreeableness	-.22*	.01
Conscientiousness	-.036	.09
Neuroticism	.22*	.08
Openness	.29**	-.007
Mental Health	.28**	.20**
Individual self-efficacy	.30**	.33**
Collective self-efficacy	.28**	.40**
Individual norms	.50**	.41**
Social norms	.28**	.25**

To further examine the psychosocial predictors of climate change worry, multiple regression analyses were conducted separately for EA<sub>MORE</sub> and EA<sub>LESS</sub>. Multiple regression analyses were performed in EA<sub>MORE</sub> and EA<sub>LESS</sub> separately, to assess the possible effects on climate change worry of the variables found to be significant in the correlation analysis. *Tables 5 and 6* show the results for EA<sub>MORE</sub> and EA<sub>LESS</sub> respectively. The regression model explained approximately 40% of the variance for EA<sub>MORE</sub> ( $R^2 = .42$ ) and 30% for EA<sub>LESS</sub> ( $R^2 = .29$ ).

**Table 5***Regression analysis in EA<sub>MORE</sub>. Dependent variable: climate change worry*

	$\beta$	T	P
Agreeableness	-.06	-.67	.51
Neuroticism	.07	.87	.39
Openness	.01	.08	.94
Mental health	.16	2.04	.04
Individual self-efficacy	.09	-.82	.41
Collective self-efficacy	.25	2.45	.02
Individual norms	.52	6.60	.001
Social norms	.15	2.01	.047

Note.  $R^2 = .42$ .

As shown in *Tables 5 and 6*, in the case of EA<sub>MORE</sub>, mental health, collective self-efficacy, perceived individual and social norms (the latter at the limit of statistical sig-

nificance) were found to be predictors of climate change worry, whereas in the case of EA<sub>LESS</sub>, mental health and perceived individual and social norms were significant predictors.

**Table 6**

*Regression analysis in EA<sub>LESS</sub>. Dependent variable: climate change worry*

	$\beta$	T	p
Mental health	.19	2.81	.006
Individual self-efficacy	.14	1.36	.18
Collective self-efficacy	.03	.27	.79
Individual norms	.31	4.26	.001
Social norms	.21	3.08	.002

*Note.*  $R^2 = .29$

## Discussion

The present study analysed the differences between young Italian adults who are more engaged in environmental activism (EA<sub>MORE</sub>) and their peers who are less engaged in environmental activism (EA<sub>LESS</sub>) in order to understand the predictors of climate change worry in a group of young adults in Italy. The present findings should be interpreted in light of the theoretical framework outlined in the Introduction, which conceptualizes climate change worry as a multifaceted psychological outcome shaped by individual, social, and motivational factors. The results show that EA<sub>MORE</sub> report significantly higher levels of worry about climate change than EA<sub>LESS</sub>, which confirms the *Hp.1* and is consistent with the literature linking active engagement with increased risk awareness and urgency regarding climate change (Khatibi et al., 2021).

Regarding personality traits (*Hp.2a* and *Hp.2b*), the data showed no significant differences between the two groups, which refutes the hypotheses formulated on the basis of the meta-analyses by Soutter & Möttus (2021), which pointed to positive associations between openness, kindness and conscientiousness and pro-environmental behavior. The absence of significant differences in personality traits suggests that dispositional characteristics may play a limited role in distinguishing levels of environmental engagement when compared to social and motivational factors, such as norms and self-efficacy. Furthermore, the results suggest that participation in pro-environmental behavior is determined more by motivational and situational variables (e.g. norms, self-efficacy) than by stable dispositional differences. The *Hp.3*, which predicted better mental health in EA<sub>MORE</sub>, was not confirmed: EA<sub>LESS</sub> reported significantly higher mental well-being. These findings run counter to initial expectations. While environmental activism is associated with motivation and self-efficacy, it may also involve psychological costs linked to prolonged exposure to climate-related stressors (Maran & Begotti, 2021; Léger-Goodes et al., 2022; Pihkala, 2020). *Hypothesis Hp.4*, which refers to the perception of higher level of individual and col-

lective self-efficacy among EA<sub>MORE</sub>, was confirmed. Rather than functioning as a buffer against emotional distress, higher collective self-efficacy among more engaged participants may reflect increased perceived responsibility and emotional involvement in addressing the climate crisis. In this sense, self-efficacy may amplify climate change worry by reinforcing personal and collective accountability. EA<sub>MORE</sub> reported greater confidence in their own abilities and those of the group, which is consistent with Bandura's (1982) theory and recent studies identifying self-efficacy as a crucial predictor of participation in environmental activism (Abonyi & McDermott, 2024; Innocenti et al, 2023). Finally, Hp.5 was only partially confirmed: EA<sub>MORE</sub> reported higher levels of individual norms, but no significant differences from EA<sub>LESS</sub> in social norms. This finding may reflect the increasing prevalence of climate change worry in the adolescent population, regardless of the level of activist engagement (Clayton & Parnes, 2025). The results thus suggest that while internalized norms differentiate the choice of activism, climate-related social norms appear to be an overarching feature. Regression analyses were used to further elucidate the predictors of climate change worry in the two groups. In EA<sub>MORE</sub>, climate change worry is explained by mental health, collective self-efficacy, individual norms and (at most) social norms, confirming the role of collective and normative dimensions in supporting activation. In EA<sub>LESS</sub>, however, the significant predictors are mental health and (individual and social) norms, suggesting that the experience of climate change worry is more related to general perceptions of well-being and normative belonging than to processes of collective efficacy. This fact can be explained by the perception that not everyone shares concern for the well-being of the environment. For example, research by Timmons et al. (2024) shows that many young people already underestimate how worried older generations are about climate change and that this misperception is linked to the belief that others will not come together to tackle climate change.

Overall, the results show that climate worry among young adults is an ambivalent phenomenon. On the one hand, it can serve as a driver for activism and strengthen processes of self-efficacy and normative internalization; on the other hand, it can have a negative impact on psychological well-being, especially for those who become more engaged with the climate issue through activism.

## Conclusion

Building on the existing literature on climate-related emotions and environmental engagement, this study contributes to clarifying the psychosocial factors associated with climate change worry among young adults. The results show that young adults more engaged in environmental activism report greater worry about climate change, accompanied by higher levels of individual and collective self-efficacy and stronger individual norms. This confirms the idea that worry about climate change can have an adaptive and motivational function that promotes pro-environmental action. However, the value for mental health reverses expectations: EA<sub>MORE</sub> report lower scores than EA<sub>LESS</sub>, suggesting that continued preoccupation with the climate crisis also has psychological costs. Furthermore, the two groups do not differ in terms of social norms, suggesting that worry for the climate is now widespread among young people, regardless of level of engagement in environmental activism. Overall, the hy-

potheses were only partially confirmed: while self-efficacy emerges as a central factor, personality traits do not appear to make a difference between activists and non-activists, and mental health appears to be more at risk among the most highly engaged. These findings highlight the importance of considering climate change worry not only as a potential risk to well-being, but also as a possible driver of environmental engagement. Supporting effective coping strategies may help reduce the emotional costs associated with activism.

To effectively address the impact of climate change on mental health and well-being, Lawrance et al. (2022) argue that it is essential that individuals and communities are adequately equipped and supported. This includes strategies aimed at facilitating psychological and emotional processing of experiences such as grief, loss, and fear, while promoting hopeful perspectives. It is also important to support the ability of people and social groups to imagine and envision a desirable future in order to prevent the exacerbation of existing psychological distress. Building a sense of community, developing functional adaptation strategies and promoting individual and collective agency are key elements in strengthening psychosocial resilience. Finally, active engagement in tackling the climate crisis can contribute significantly to strengthening social cohesion and a sense of shared efficacy.

## **Limitations**

The present study has some methodological and interpretative limitations. Firstly, the sample is not representative of the Italian youth population: data collection through social networks and platforms linked to environmental movements may have favored the participation of participants who are already sensitized to the issue. Secondly, due to the cross-sectional nature of the research design, it is not possible to establish causal relationships between the variables, which limits the possibility of understanding whether climate change worries precede or result from activism. To better understand the process linking the variables, future research could utilize a longitudinal design that measures whether climate change worry increases or decreases as a result of respondents' engagement before and during environmental activism. Thirdly, our study includes young adults who are engaged in environmental activism to varying degrees. In doing so, we did not examine some variables (*e.g.*, political beliefs, motivation, and individual values) that might be useful for understanding the reasons for engagement in these activities. Future research could benefit from examining the principles that inspire engagement in environmental activism. Another limitation concerns the use of self-reporting, which can be influenced by social desirability, particularly in relation to pro-environmental behaviors and active engagement. Future research could incorporate social desirability instruments (on this topic, see Oerke & Bogner, 2013). Moreover, particularly among young people, to whom media coverage of this topic is dedicated, climate change worry can be perceived as an issue that is considered essential, making it impossible not to declare oneself worried in some way. This is also evident from the work of Benoit et al. (2022) on media coverage of climate change. Newspaper articles often portray children and young people and their reflective perspectives and experiences of climate change as young activists and saviors of the planet. Thus, the analysis

did not consider relevant contextual variables such as the extent of media exposure and perceived social support which could influence the intensity of climate change worry (see Maran & Begotti, 2021). Future studies could therefore also take media exposure and social media presence into account. In addition, the use of the BFI-10, while useful for brevity, reduces reliability in the multifaceted measurement of personality traits. In future research, the adoption of more comprehensive psychological well-being measures may provide a more nuanced understanding of the relationship between climate change worry and psychological functioning. Specifically, multidimensional well-being scales could capture positive psychological functioning more precisely than general mental health indices, thereby enriching the interpretation of emotional responses to climate change. More broadly, future research could also incorporate alternative personality models that increase measurement accuracy; for example, Feher and Vernon (2021) suggest the use of the HEXACO model when examining morally relevant outcomes.

### **Ethics Statement**

This study obtained ethics approval from the University of Torino (Prot. N. 0421423).

### **Informed Consent from the Participants**

All the participants filled in the informed consent form before taking part.

### **Author Contributions**

All authors contributed to the conception, design, analysis, and interpretation of the study. All authors reviewed and approved the final version of the manuscript.

### **Conflict of Interest**

The authors declare no conflict of interest.

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### **References**

- Abonyi, A., & McDermott, M. (2024). How to increase engagement with environmentalism: Perceived threat, behavioural control, and subjective norms as psychological predictors of eco-activism. *Journal of Ecopsychology*, 4, 1–16. <https://joe.nationalwellbeingsservice.com/volumes/volume-4-2024/volume-4-article-6/>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Alisat, S., & Riemer, M. (2015). The environmental action scale: Development and psychometric evaluation. *Journal of Environmental Psychology*, 43, 13–23. <https://doi.org/10.1016/j.jenvp.2015.05.006>
- Bain, P.G., & Bongiorno, R. (2020). It's not too late to do the right thing: Moral motivations for climate change action. *Wiley Interdisciplinary Reviews: Climate Change*, 11(1), e615. <https://doi.org/10.1002/wcc.615>

- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37(2), 122–147. <https://doi.org/10.1037/0003-066X.37.2.122>
- Bech, P., Gudex, C., & Staehr Johansen, K. (1996). The WHO (Ten) well-being index: Validation in diabetes. *Psychotherapy and Psychosomatics*, 65(4), 183–190. <https://doi.org/10.1159/000289073>
- Benoit, L., Thomas, L., & Martin, A. (2022). Ecological awareness, anxiety, and actions among youth and their parents—a qualitative study of newspaper narratives. *Child and Adolescent Mental Health*, 27(1), 47–58. <https://doi.org/10.1111/camh.12514>
- Bulbena-Vilarrasa, A., & Bulbena-Cabré, A. (2024). Anxiety: Worry and beyond. In *The Symptom-Based Handbook for Ehlers-Danlos Syndromes and Hypermobility Spectrum Disorders* (pp. 115–121). Elsevier. <https://doi.org/10.1016/B978-0-323-95082-4.00005-0>
- Cianconi, P., Hanife, B., Grillo, F., Lesmana, C.B.J., & Janiri, L. (2023). Eco-emotions and psychoterratic syndromes: Reshaping mental health assessment under climate change. *The Yale Journal of Biology and Medicine*, 96(2), 211. <https://doi.org/10.59249/EARX2427>
- Clayton, S., & Karaszia, B.T. (2020). Development and validation of a measure of climate change anxiety. *Journal of Environmental Psychology*, 69, 101434. <https://doi.org/10.1016/j.jenvp.2020.101434>
- Clayton, S., & Parnes, M.F. (2025). Anxiety and activism in response to climate change. *Current Opinion in Psychology*, 101996. <https://doi.org/10.1016/j.copsyc.2025.101996>
- Doran, R., Hanss, D., & Larsen, S. (2015). Attitudes, efficacy beliefs, and willingness to pay for environmental protection when travelling. *Tourism and Hospitality Research*, 15(3), 281–292. <https://doi.org/10.1177/1467358415580360>
- Doran, R., Hanss, D., & Larsen, S. (2017). Intentions to make sustainable tourism choices: Do value orientations, time perspective, and efficacy beliefs explain individual differences? *Scandinavian Journal of Hospitality and Tourism*, 17(2), 223–238. <https://doi.org/10.1080/15022250.2016.1179129>
- Doran, R., & Larsen, S. (2016). The relative importance of social and personal norms in explaining intentions to choose eco-friendly travel options. *International Journal of Tourism Research*, 18(2), 159–166. <https://doi.org/10.1002/jtr.2042>
- Feher, A., & Vernon, P.A. (2021). Looking beyond the Big Five: A selective review of alternatives to the Big Five model of personality. *Personality and Individual Differences*, 169, 110002. <https://doi.org/10.1016/j.paid.2020.110002>
- Fielding, K.S., McDonald, R., & Louis, W.R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. *Journal of Environmental Psychology*, 28(4), 318–326. <https://doi.org/10.1016/j.jenvp.2008.03.003>
- Innocenti, M., Santarelli, G., Faggi, V., Ciabini, L., Castellini, G., Galassi, F., & Ricca, V. (2022). Psychometric properties of the Italian version of the climate change worry scale. *The Journal of Climate Change and Health*, 6, 100140. <https://doi.org/10.1016/j.joclim.2022.100140>
- Innocenti, M., Santarelli, G., Lombardi, G.S., Ciabini, L., Zjalic, D., Di Russo, M., & Cadeddu, C. (2023). How can climate change anxiety induce both pro-environmental behaviours and eco-paralysis? The mediating role of general self-efficacy. *International Journal of Environmental Research and Public Health*, 20(4), 3085. <https://doi.org/10.3390/ijerph20043085>
- ISTAT. (2025). *Rapporto “Il Volontariato”* (Report “Volunteering”). [https://www.istat.it/wp-content/uploads/2025/07/REPORT\\_Il-volontariato-in-Italia\\_anno-2023.pdf](https://www.istat.it/wp-content/uploads/2025/07/REPORT_Il-volontariato-in-Italia_anno-2023.pdf)
- Jew, G., & Tran, A.G. (2022). Understanding activist intentions: An extension of the theory of planned behavior. *Current Psychology*, 41(7), 4885–4897. <https://doi.org/10.1007/s12144-020-01007-5>
- John, O.P., Donahue, E.M., & Kentle, R.L. (1991). *The Big Five Inventory—Versions 4a and 54*. University of California, Berkeley, Institute of Personality and Social Research.
- Khatibi, F.S., Dedekorkut-Howes, A., Howes, M., & Torabi, E. (2021). Can public awareness, knowledge and engagement improve climate change adaptation policies? *Discover Sustainability*, 2(1), 18. <https://doi.org/10.1007/s43621-021-00024-z>
- Kurt, G., & Akdur, R. (2024). Under what conditions does climate change worry contribute to climate action in Turkey: What moderates this relationship? *Sustainability*, 16(6), 2269. <https://doi.org/10.3390/su16062269>

- Lawrance, E.L., Thompson, R., Newberry Le Vay, J., Page, L., & Jennings, N. (2022). The impact of climate change on mental health and emotional wellbeing: A narrative review of current evidence, and its implications. *International Review of Psychiatry*, 34(5), 443–498. <https://doi.org/10.1080/09540261.2022.2128725>
- Léger-Goodes, T., Malboeuf-Hurtubise, C., Mastine, T., Généreux, M., Paradis, P.O., & Camden, C. (2022). Eco-anxiety in children: A scoping review of the mental health impacts of the awareness of climate change. *Frontiers in Psychology*, 13, 872544. <https://doi.org/10.3389/fpsyg.2022.872544>
- Lenart-Gansiniec, R., Czakon, W., & Pellegrini, M.M. (2022). In search of virtuous learning circles: Absorptive capacity and its antecedents in the education sector. *Journal of Knowledge Management*, 26(11), 42–70. <https://doi.org/10.1108/JKM-10-2021-0734>
- López-García, L., Latorre, F., Vecina, M.L., & Díaz-Silveira, C. (2025). What drives pro-environmental behavior? Investigating the role of eco-worry and eco-anxiety in young adults. *Sustainability*, 17(10), 4543. <https://doi.org/10.3390/su17104543>
- Maran, D.A., & Begotti, T. (2021). Media exposure to climate change, anxiety, and efficacy beliefs in a sample of Italian university students. *International Journal of Environmental Research and Public Health*, 18(17), 9358. <https://doi.org/10.3390/ijerph18179358>
- Oerke, B., & Bogner, F.X. (2013). Social desirability, environmental attitudes, and general ecological behaviour in children. *International Journal of Science Education*, 35(5), 713–730. <https://doi.org/10.1080/09500693.2011.566897>
- Ogunbode, C.A., Salmela-Aro, K., Acquadro Maran, D., van den Broek, K., Doran, R., Lins, S., Torres-Marín, J., Navarro-Carrillo, G., Rocchi, G., & Schermer, J.A. (2024). Do neuroticism and efficacy beliefs moderate the relationship between climate change worry and mental wellbeing? *Journal of Affective Disorders*, 364, 37–40. <https://doi.org/10.1016/j.jad.2024.01.042>
- Ojala, M. (2012). Regulating worry, promoting hope: How do children, adolescents, and young adults cope with climate change? *International Journal of Environmental and Science Education*, 7(4), 537–561. <https://eric.ed.gov/?id=EJ997146>
- Ojala, M., & Bengtsson, H. (2019). Young people's coping strategies concerning climate change: Relations to perceived communication with parents and friends and pro-environmental behavior. *Environment and Behavior*, 51(8), 907–935. <https://doi.org/10.1177/0013916518777621>
- Ojala, M., Cunsolo, A., Ogunbode, C.A., & Middleton, J. (2021). Anxiety, worry, and grief in a time of environmental and climate crisis: A narrative review. *Annual Review of Environment and Resources*, 46(1), 35–58. <https://doi.org/10.1146/annurev-environ-012220-022716>
- Orrù, L., Taccini, F., & Mannarini, S. (2024). Worry about the future in the climate change emergency: A mediation analysis of the role of eco-anxiety and emotion regulation. *Behavioral Sciences*, 14(3), 255. <https://doi.org/10.3390/bs14030255>
- Parmentier, M.L., Weiss, K., Aroua, A., Betry, C., Rivière, M., & Navarro, O. (2024). The influence of environmental crisis perception and trait anxiety on the level of eco-worry and climate anxiety. *Journal of Anxiety Disorders*, 101, 102799. <https://doi.org/10.1016/j.janxdis.2023.102799>
- Pihkala, P. (2020). Anxiety and the ecological crisis: An analysis of eco-anxiety and climate anxiety. *Sustainability*, 12(19), 7836. <https://doi.org/10.3390/su12197836>
- Ratner, C. (1991). *Vygotsky's sociohistorical psychology and its contemporary applications*. Springer. <https://doi.org/10.1007/978-1-4899-2614-2>
- SWG. (2019). *Lotta contro i cambiamenti climatici* [Fight Against Climate Change]. <https://www.swg.it/politicapp?id=yedv>
- Soutar, C., & Wand, A.P. (2022). Understanding the spectrum of anxiety responses to climate change: A systematic review of the qualitative literature. *International Journal of Environmental Research and Public Health*, 19(2), 990. <https://doi.org/10.3390/ijerph19020990>
- Soutter, A.R.B., & Möttus, R. (2021). Big Five facets' associations with pro-environmental attitudes and behaviors. *Journal of Personality*, 89(2), 203–215. <https://doi.org/10.1111/jopy.12576>
- Stewart, A.E. (2021). Psychometric properties of the climate change worry scale. *International Journal of Environmental Research and Public Health*, 18(2), 494. <https://doi.org/10.3390/ijerph18020494>

- Taylor, S. (2020). Anxiety disorders, climate change, and the challenges ahead: Introduction to the special issue. *Journal of Anxiety Disorders*, 76, 102313. <https://doi.org/10.1016/j.janxdis.2020.102313>
- Timmons, S., Andersson, Y., & Lunn, P.D. (2024). Communicating climate change as a generational issue: Experimental effects on youth worry, motivation and belief in collective action. *Climate Policy*, 24(10), 1457–1473. <https://doi.org/10.1080/14693062.2024.2341080>
- Tucholska, K., Gulla, B., & Ziernicka-Wojtaszek, A. (2024). Climate change beliefs, emotions and pro-environmental behaviors among adults: The role of core personality traits and the time perspective. *PLoS One*, 19(4), e0300246. <https://doi.org/10.1371/journal.pone.0300246>
- Vecina, M.L., Alonso-Ferres, M., & Díaz-Silveira, C. (2025). Eco-anxiety or simply eco-worry? Incremental validity study in a representative Spanish sample. *Frontiers in Psychology*, 16, 1560024. <https://doi.org/10.3389/fpsyg.2025.1560024>

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## PSYCHOMETRICS

### Validation of the Relational Self-Esteem Scale in Ecuador: Unidimensional Structure and Gender Invariance

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**Background.** Relational self-esteem — self-worth derived from significant relationships — is central to psychosocial functioning. However, brief measures validated with appropriate methods for ordinal items are scarce in Ecuadorian populations.

**Objective.** To examine the factorial structure, internal consistency, convergent validity, and gender-based measurement invariance of the Relational Self-Esteem Scale (RSE), using a cross-validation approach.

**Design.** Instrumental, cross-sectional study with  $n = 1.478$  Ecuadorian adults. The sample was split for cross-validation: 40% ( $n = 591$ ) for EFA and 60% ( $n = 887$ ) for CFA. EFA used a polychoric matrix, ULS extraction, and oblimin rotation; factor retention was guided by parallel analysis. CFA employed WLSMV. Convergent validity was tested against personal self-esteem (RSES), collective self-esteem (CSE), and mental well-being (MHC-SF). Multigroup measurement invariance by gender was assessed (configural, metric, scalar, strict).

**Results.** Parallel analysis and confirmatory factor analysis supported a unidimensional structure with robust factor loadings and an adequate overall model fit. The scale demonstrated high internal consistency and reliability. Convergent validity was established through significant positive correlations with measures

**Keywords:** relational self-esteem, Ecuador, self-esteem, invariance, gender, confirmatory factor analysis

of self-esteem, core self-evaluations, and mental health. The instrument showed full measurement invariance across genders, meeting all criteria from configural to strict levels.

**Conclusion.** The RSE shows a unidimensional structure, adequate reliability, convergent validity, and gender invariance in Ecuadorian adults. Findings support using the total score as a brief, valid indicator of relational self-esteem in this context.

## Introduction

Self-esteem is a central component of psychological functioning and subjective well-being. Traditionally, it has been defined as the global and affective evaluation that one makes of oneself (Rosenberg, 1965). Longitudinal research has shown that high self-esteem prospectively predicts success and well-being in fundamental areas such as relationships, work, and health (Orth & Robins, 2014). A recent quantitative synthesis of 40 meta-analyses (Zell & Johansson, 2024) evidenced a solid relationship between self-esteem and well-being, consistent across different cultural regions. Likewise, self-esteem has been identified as a protective factor that buffers the effects of stress and promotes psychological resilience (Tang et al., 2024). The role of self-esteem can also be conditioned by contextual factors, through a relational and dynamic process, dependent on social interaction and symbolic ties with others (Jiang, 2020).

However, the conception of the self is not universal; there are different forms of self-definition depending on the cultural context: the “independent self,” centered on internal and unique attributes, and the “interdependent self,” which emphasizes connection and relationships with others (Markus & Kitayama, 1991). From this perspective, sources of self-evaluation may go beyond the individual, including relational and collective dimensions. Brewer and Gardner (1996) proposed a tripartite model of the self — personal, relational, and collective — that integrates different forms of self-representation with differentiated origins and sources of self-evaluation.

Based on this approach, Luhtanen and Crocker (1992) developed the Collective Self-Esteem Scale, and later Du, King, and Chi (2012) introduced the Relational Self-Esteem Scale (RSE), defining relational self-esteem as the positive evaluation of oneself derived from meaningful relationships with other people. This approach is aligned with the notion of relational–interdependent self-construal (Cross, Bacon, & Morris, 2000) and with the relational levels of self-definition described by Brewer and Gardner (1996).

Since its development, the RSE has demonstrated predictive relevance, being positively associated with life satisfaction (Du, King, & Chi, 2017) and negatively with perceived stress (Tang et al., 2024). Nevertheless, an analysis of its psychometric evidence reveals two crucial issues: ambiguity in its factor structure and a marked geographical concentration of studies in the Asian context (Du et al., 2012; Du et al., 2016). Although its reliability is consistently adequate, with Cronbach’s alpha coefficients above .70 (Du et al., 2016; Li et al., 2022), its internal structure is inconsistent. The original study supported a one-dimensional model in university students (Du et

al., 2012), whereas a later study found that a two-factor model (family and friends) fit better in a rural community sample (Du et al., 2016). Finally, regarding measurement invariance, the researchers confirmed factorial invariance of the scale between a clinical sample (HIV-positive caregivers) and a non-clinical sample (HIV-negative caregivers) (Du et al., 2016).

The literature review reflects the broad application of this scale across various studies. Beyond the predictive associations mentioned above, research has also linked the instrument to constructs such as happiness and positive affect (Du et al., 2017), as well as personal self-esteem, resilience, and social support (Du et al., 2016), among others. In addition, relational self-esteem has shown moderation by gender in gender stereotypes in men (Li, Liu, & Song, 2022); however, there is a risk that the relationship between items and construct is not equivalent in men and women, since there are no studies that analyze gender invariance. It is generally assumed that scales measure constructs in the same way across different groups (Byrne, 2006); however, differences may be due to the instrument having different factorial solutions depending on the comparison group (Asparouhov & Muthén, 2014). Therefore, it is important to analyze invariance by group to avoid this type of error.

Despite the growing international evidence, the measurement of relational self-esteem in Latin American contexts is still limited (Barreda Parra, 2021; Diiori, 2018; Yomtov et al., 2015). The evidence on the psychometric properties of the tool has been mainly in the Asian context (Du et al., 2012; Du, Li, et al., 2018), in which cultural conceptions of the “self” and relationships may differ substantially from Latin American cultural conceptions (Oyserman et al., 2002). In this regard, the need has been noted to adapt and validate measures that capture the particularities of relational experience in interdependent societies, where the sense of belonging and emotional reciprocity play a central role in the construction of personal identity.

In Ecuador, and in Latin America in general, family, community, and friendship relationships are fundamental sources of emotional support and self-esteem (Moreta-Herrera et al., 2025; Valle Pico, 2022). However, to date no psychometric evidence has been found regarding the validity and reliability of instruments that assess relational self-esteem in this context. Having an adapted and validated measure would allow progress in understanding the social and emotional predictors of well-being, as well as in the design of cultural and educational interventions aimed at strengthening interpersonal bonds.

The present study thus seeks to contribute to the development of culturally sensitive psychometric tools for the study of the relational self in Latin America, and to strengthen the understanding of the role that interpersonal relationships play in the construction of self-esteem and mental health in interdependent social contexts.

The study’s objective is to identify validity evidence from Classical Test Theory (CTT) for the RSE in a large Ecuadorian sample. It is hypothesized that the RSE presents an adequate internal structure (H1), as well as convergent validity with other measures of self-esteem and mental health (H2); that the RSE also has adequate reliability of internal consistency (H3); and that the RSE has properties of measurement equivalence based on gender (H4).

## Methods

The present study corresponds to a descriptive work of an instrumental nature or an analysis of psychometric properties (Ato et al., 2013), in which validity evidence of the RSE is analyzed in a sample of university students from Ecuador.

### Participants

The sample consisted of 1,478 people residing in Ecuador, selected through non-probability incidental sampling. Participants' ages ranged from 18 to 78 years ( $M=23.93$ ;  $SD=7.27$ ), of whom 56.6% were women and 43.4% men. All participants voluntarily completed the online questionnaire, guaranteeing anonymity and confidentiality of responses.

### Instruments

*The Relational Self-Esteem Scale* (RSE) developed by Du et al. (2012) assesses the degree to which people experience a positive evaluation of themselves based on their meaningful interpersonal relationships. It consists of 7 items with a 7-point Likert-type response format (1 = Strongly disagree to 7 = Strongly agree), where higher scores reflect greater relational self-esteem. Example items: "I am a worthy member of my circle of friends," "I think my family is proud of me." Regarding internal consistency in the study, the values were excellent ( $\alpha = .86$ , 95% CI [.85, .88];  $\omega = .86$ ; 95% CI [.85, .87]). The Spanish version of the instrument was obtained through a back-translation process conducted in a prior international study. This involved translation by native bilingual speakers and a subsequent back-translation by a committee of psychologists to ensure conceptual and linguistic equivalence with the original version.

*The Rosenberg Self-Esteem Scale* (RSES; Rosenberg, 1965) in the Spanish version validated in Ecuador (Bueno-Pacheco et al., 2020). It is one of the most widely used instruments to assess global self-esteem. It consists of 10 items with a 4-point Likert format (1 = Strongly disagree to 4 = Strongly agree). Example item: "I feel that I have positive qualities." Five items are worded negatively and require reverse scoring before computing the total score. The scale assesses a general factor of global self-esteem, understood as the affective and cognitive evaluation that one makes of oneself. Regarding reliability estimates, the following were obtained ( $\alpha = .79$ , 95% CI [.76, .81];  $\omega = .78$ ; 95% CI [.75, .80]).

*The Collective Self-Esteem Scale* (CES; Luhtanen & Crocker, 1992) measures the degree to which people positively value their belonging to social groups to which they belong. It is composed of 16 items, distributed in four subscales of 4 items each: Membership Collective Self-Esteem (e.g., "I am a worthy member of the groups I belong to"), Private Collective Self-Esteem (e.g., "I am proud of the groups I belong to"), Public Collective Self-Esteem (e.g., "Overall, others think positively of the groups I belong to"), and Importance to Identity (e.g., "Belonging to my groups is an important part of my self-concept"). Responses are recorded on a 7-point Likert format (1 = Strongly disagree to 7 = Strongly agree). Regarding reliability, the results were as follows ( $\alpha = .88$ , 95% CI [.86, .89];  $\omega = .83$ ; 95% CI [.82, .84]).

*The Mental Health Continuum-Short Form* (MHC-SF; Keyes, 2002) in the Spanish version validated in the Ecuadorian context (Moreta-Herrera et al., 2025). The

MHC-SF evaluates positive mental well-being through 14 items that measure three dimensions: a) Emotional well-being (e.g., “During the past month, how often did you feel happy?”); b) Psychological well-being (e.g., “During the past month, how often did you feel that your life has a sense of meaning?”); and c) Social well-being (e.g., “During the past month, how often did you feel that you belong to a community?”). Items are answered on a 6-point Likert scale (0 = Never to 5 = Every day). In this study, high reliability was obtained ( $\alpha = .95$ , 95% CI [.94 – .95] and  $\omega = .95$ , 95% CI [.94 – .95]).

### **Procedure**

Data were collected through an online survey designed in Qualtrics, within the framework of the Predictors of Mental Health in Ecuador Project, which is pre-registered in the Open Science Framework (OSF). Participation was voluntary, after reading and accepting the informed consent, approved by the corresponding institutional ethics committee (CEISH-UISEK-EX-EO-2024-002-2). No financial incentives were offered.

### **Data Analysis**

To ensure the robustness and replicability of the model, the total sample ( $N = 1,478$ ) was randomly divided into two independent subsamples: 40% ( $n = 591$ ) was used for the exploratory factor analysis (EFA) and the remaining 60% ( $n = 887$ ) for the confirmatory factor analysis (CFA). This cross-validation strategy avoids overfitting and allows verifying the stability of the factor structure in an independent sample (Brown, 2015; Worthington & Whittaker, 2006).

1. Reliability: Cronbach’s  $\alpha$  and McDonald’s  $\omega$  coefficients were estimated with their respective 95% confidence intervals (95% CI), as well as item–total correlations and  $\omega$  values if the item was deleted.

2. Exploratory factor analysis (EFA): Given the ordinal nature of the items, a polychoric correlation matrix was estimated and unweighted least squares (ULS) was used as the extraction method, due to its robustness to non-normality and its compatibility with polychoric matrices. The adequacy of the matrix was verified using the KMO index and Bartlett’s sphericity test, and factor retention was determined by parallel analysis.

3. Confirmatory factor analysis (CFA) was estimated using the WLSMV (Weighted Least Squares Mean and Variance Adjusted) method, due to the ordinal nature of the responses and the absence of multivariate normality. The fit indices evaluated were: chi-square ( $\chi^2$ ), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) with 90% confidence intervals (90% CI), and Standardized Root Mean Square Residual (SRMR), following the criteria of Hu and Bentler (1999).

4. Convergent validity was assessed through a matrix of Pearson correlations between the RSE and the other psychological measures (collective self-esteem, personal self-esteem, and mental health).

5. Multigroup factorial invariance was tested by gender through multigroup CFA (MG-CFA), following the configural, metric (loadings), scalar (intercepts), and strict

(residuals) sequence, with WLSMV estimation. Invariance was evaluated based on changes in CFI ( $\leq .010$ ) and RMSEA ( $\leq .015$ ) between nested models (Cheung & Rensvold, 2002).

All analyses were performed in JASP 0.95.3 and JAMOVI 2.6.26, reporting 95% confidence intervals.

## Results

The reliability of the Relational Self-Esteem Scale (RSE) was high, with  $\alpha = .869$ , 95% CI [.852 – .885] and  $\omega = .869$ , 95% CI [.859 – .879], indicating excellent internal consistency. Item–total correlations ranged from .61 to .77, and omega coefficients if the item was deleted remained high (.844 – .900), confirming the homogeneity of the construct (Table 1).

**Table 1**

*Reliability Statistics of the Relational Self-Esteem Scale*

Item	$\omega_{id}$	$\alpha_{id}$	Itr	M	SD	Skewness	Kurtosis
I am a worthy member of my circle of friends.	.890	.889	.702	4.637	1.922	-.372	-.846
I feel I have much to offer to my family.	.884	.883	.755	4.862	1.852	-.506	-.624
In general, I'm glad to be a member of my circle of friends.	.887	.885	.732	4.846	1.793	-.442	-.598
I am proud of my family	.894	.893	.666	4.781	1.709	-.378	-.378
Overall, my circle of friends is considered to be good by others.	.883	.881	.771	5.085	1.754	-.609	-.389
I think my family is proud of me.	.887	.885	.740	5.018	1.759	-.611	-.391
I can help my friends a lot.	.900	.898	.615	4.903	1.771	-.493	-.541

*Note.*  $\Omega_{id}$ =Omega if item dropped;  $\alpha_{id}$ =alpha if item dropped; Itr=Item total correlation; M=Mean; SD=Standard Deviation

The EFA was performed on the first subsample (40%,  $n = 591$ ) with a matrix of polychoric correlations. It began with the test of sampling adequacy,  $KMO = .883$ , and Bartlett's test of sphericity  $\chi^2(21) = 1431.80$ ,  $p < .001$ , which indicated the relevance of the analysis. In addition, parallel analysis suggested a unifactorial structure, with a single component with an eigenvalue of 3.26, which explained 47.8% of the total variance. Factor loadings ( $\lambda$ ) ranged from .64 (*item 7*) to .82 (*item 5*), all exceeding the minimum recommended threshold of  $\lambda > .40$ .

With respect to the CFA, the one-dimensional model proposed by the EFA was tested in the second subsample (60%,  $n = 887$ ) through CFA with WLSMV estimation. This confirmed the model, showing adequate fit indices:  $\chi^2(11) = 70.25$ ,  $p < .001$ ; CFI = .990; TLI = .981; RMSEA = .077 [90% CI .060–.094]; SRMR = .021. Likewise, all item factor loadings were significant ( $p < .001$ ) and ranged from .59 (*item 7*) to .75 (*item 5*). Moreover, item  $R^2$  values ranged from .38 (*item 7*) to .55 (*item 2*). Finally,

composite reliability was  $\omega = .817$  and  $\alpha = .870$ , confirming the internal stability of the model.

In addition, modification indices were inspected. Three theoretically justified residual covariances were retained: (a) AUTREL1  $\leftrightarrow$  AUTREL2, due to semantic overlap in belonging/affect within the friends referent; (b) AUTREL6  $\leftrightarrow$  AUTREL7, for sharing a common source of evaluation (hetero-evaluation); and (c) AUTREL4  $\leftrightarrow$  AUTREL5, for a prosocial style/positive valuation of the group and one's own contribution. These covariances were kept equal by gender in the multigroup models (or freed if necessary), and their inclusion improved fit without altering the one-factor structure. As a sensitivity analysis, the same model was estimated without residual covariances; fit decreased ( $\Delta CFI/\Delta RMSEA$ ), supporting the local need for these correlations by content and method.

Regarding convergent validity (Table 2), the correlation of the RSE with the RSES ( $r = .201, p < .001$ ) and with the CES ( $r = .421, p < .001$ ) shows significant and positive relationship with conceptually related measures. The MHC correlated positively and significantly with the RSE ( $r = .125, p < .001$ ), RSES ( $r = .462, p < .001$ ), and CES ( $r = .236, p < .001$ ).

**Table 2**

*Bivariate Correlations and Confidence Intervals among the RSE, RSES, CES, and MHC-SF*

		1	2	3	4
1. RSE	Pearson's R	—			
	Higher 95% CI	—			
	Lower 95% CI	—			
2. RSES	Pearson's R	.20***	—		
	Higher 95% CI	.25	—		
	Lower 95% CI	.15	—		
3. CES	Pearson's R	.42***	.02	—	
	Higher 95% CI	.46	.07	—	
	Lower 95% CI	.38	-.03	—	
4. MHC	Pearson's R	.12***	.46***	.23***	—
	Higher 95% CI	.17	.50	.27	—
	Lower 95% CI	.07	.42	.18	—

Note. \*\*\*  $p < .001$

Factorial invariance (Table 3) by gender was evaluated through multigroup confirmatory factor analysis with WLSMV estimation. The configural model showed acceptable fit ( $\chi^2(22) = 85.91$ ; CFI = .990; TLI = .980; RMSEA = .080 [.062-.098]; SRMR = .024), supporting structural equivalence. The metric model showed equivalent indices ( $\chi^2(28) = 89.64$ ; CFI = .990; TLI = .985; RMSEA = .069 [.054-.086]; SRMR = .028), with  $\Delta CFI = .000$  and  $\Delta RMSEA = -.011$ , supporting metric invariance. The scalar model, with equal thresholds, maintained excellent fit ( $\chi^2(62) = 109.36$ ;

CFI = .992; TLI = .995; RMSEA = .041 [.028–.053]; SRMR = .025), and changes relative to the metric model were minimal ( $\Delta$ CFI = +.002;  $\Delta$ RMSEA = -.028), confirming scalar invariance. Finally, the strict model, with additional equality of residual variances, presented an equally adequate fit ( $\chi^2(65) = 109.42$ ; CFI = .993; TLI = .995; RMSEA = .039 [.026–.051]; SRMR = .025), with  $\Delta$ CFI = +.001 and  $\Delta$ RMSEA = -.002, which confirms strict invariance by gender.

**Table 3**

*Summary of Fit Indices for the Measurement Invariance Models of the Relational Self-Esteem Scale across Gender Groups*

Model	$\chi^2$ (df)	CFI	TLI	RMSEA [IC90%]	SRMR	$\Delta$ CFI	$\Delta$ RMSEA
Configural	85.91 (22)	.990	.980	.080 [.062–.098]	.024	—	—
Metric	89.64 (28)	.990	.985	.069 [.054–.086]	.028	.000	-.011
Scalar	109.36 (62)	.992	.995	.041 [.028–.053]	.025	+.002	-.028
Strict	109.42 (65)	.993	.995	.039 [.026–.051]	.025	+.001	-.002

*Note.*  $\chi^2(df)$  = chi-square goodness; CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA [90% CI] = Root Mean Square Error of Approximation with 90% confidence interval; SRMR = Standardized Root Mean Square Residual;  $\Delta$ CFI,  $\Delta$ RMSEA = change in CFI/RMSEA relative to the less constrained model.

## Discussion

The present study aimed to analyze the psychometric properties of the Relational Self-Esteem Scale (RSE) in a large sample of the Ecuadorian population. Taken together, the results support the reliability, validity, and one-dimensional structure of the instrument, confirming its suitability for evaluating self-esteem based on interpersonal relationships in Latin American contexts. The internal consistency indices were excellent, indicating high homogeneity among items and adequate representativeness of the construct. These values exceed the criteria recommended by Nunnally and Bernstein (1994) and are comparable to findings reported in previous studies with Asian populations (Du et al., 2012; Du et al., 2017; Li et al., 2022), where the RSE showed reliabilities between .88 and .93. The high item–total correlation and the stability of  $\omega$  coefficients if an item is removed reinforce the idea that all items contribute significantly to measuring the same latent factor.

The exploratory factor analysis revealed a one-factor structure, supported by an eigenvalue of 3.26 that explained 47.8% of the total variance. The KMO and Bartlett's tests confirmed the suitability of the data, and all factor loadings were above .40, showing clear internal coherence. These results support the theoretical conception of relational self-esteem as a one-dimensional construct centered on the perception of being valued and accepted by others (Cross et al., 2000; Du et al., 2017).

The confirmatory factor analysis using the WLSMV estimator corroborated this one-factor model, showing excellent fit indices. The factor loadings were statistically significant and of high magnitude, indicating that the items adequately reflect the latent dimension. These results are consistent with the original proposal (Du et al.,

2012), but contrast with the bifactor model in a rural community sample (Du et al., 2016).

Regarding convergent validity, the average variance extracted (AVE) was .49, close to the recommended threshold of .50 (Fornell & Larcker, 1981), which indicates adequate convergence of items on the construct. The correlation with personal self-esteem, in line with Du et al. (2016), and with collective self-esteem confirms its theoretical coherence as a component of self-evaluation nurtured by social interactions and a sense of belonging. In addition, a positive relationship with psychological well-being (MHC) was found, in the expected direction. These results support that self-esteem based on positive relationships is associated with greater well-being and lower psychological symptomatology, which is consistent with previous evidence on the protective role of relational self-esteem against emotional distress (Du et al., 2017; Neff & McGehee, 2010).

Regarding factorial invariance by gender, multigroup analyses demonstrated configural, metric, scalar, and strict invariance, with minimal differences between models ( $\Delta CFI \leq .002$ ;  $\Delta RMSEA \leq .015$ ). This indicates that the scale measures the same construct with the same structure and meaning for men and women, allowing valid comparisons between groups. This finding is particularly relevant, since the literature has pointed out possible gender differences in the internalization of relational self-esteem (Cross & Madson, 1997), but the current results suggest that the construct operates equivalently in both genders within the Ecuadorian context.

Taken together, the results confirm the Relational Self-Esteem Scale as a reliable, valid, and gender-invariant measure for evaluating self-esteem linked to interpersonal relationships. Its statistical adequacy, together with its brevity and ease of application, make it a useful tool for research on well-being, identity, and mental health in Latin American populations.

## **Conclusion**

The results support the reliability, validity, and one-dimensional structure of the Relational Self-Esteem Scale in the Ecuadorian population, confirming its factorial equivalence by gender. The scale constitutes a psychometrically solid tool for the study of the relational self, providing evidence on the importance of meaningful relationships as a source of personal evaluation in Latin American contexts.

## **Limitations**

Despite the robustness of the findings, the study presents some limitations. First, the sample was non-probabilistic and predominantly urban and young, which limits generalization to other age groups or rural contexts. Future studies should replicate these analyses with representative samples and longitudinal designs, as well as explore cultural invariance in other Latin American countries. In addition, it would be pertinent to examine the relationship of the RSE with indicators of social support, relational identity, and interpersonal stress, thereby expanding its external validity.

Taken together, these findings underscore the importance of considering the relational dimension of the self as an essential component of well-being. In interdependent cultural contexts such as Latin American ones, where family and community relationships may be axes of identity and emotional support, relational self-esteem can constitute a strategic psychosocial resource for the design of public policies, mental health programs, and educational actions centered on the collective construction of well-being.

### **Ethics Statement**

Ethical approval for the project was granted by the CEISH-UISEK (approval number CEISH-UISEK-EX-EO-2024-002-2).

### **Author Contributions**

LFA and JMR conceived the idea. LFA directed the project and analyzed the data. MLM and LAG wrote the paper. VRDC performed the translation, and MHCR revised and corrected the final version.

### **Conflict of Interest**

The authors declare no conflict of interest.

### **References**

- Asparouhov, T., & Muthén, B. (2014). Multiple-group factor analysis alignment. *Structural Equation Modeling: A Multidisciplinary Journal*, 21(4), 495–508. <https://doi.org/10.1080/10705511.2014.919210>
- Ato, M., López-García, J.J., & Benavente, A. (2013). Un sistema de clasificación de los diseños de investigación en psicología [A classification system for research designs in psychology]. *Anales de Psicología* [Annals of Psychology], 29(3), 1038–1059. <https://doi.org/10.6018/analesps.29.3.178511>
- Barreda Parra, A. (2021). *Análisis sobre el rol de los factores personales y sociales en la autoestima de estudiantes universitarios: Un estudio transcultural*. [Analysis of the role of personal and social factors in the self-esteem of university students: A cross-cultural study] [Doctoral dissertation, Seville University]. <https://idus.us.es/items/71e38001-8093-4934-b598-b04455d61cb3>
- Brewer, M.B., & Gardner, W. (1996). Who is this “we”? Levels of collective identity and self-representations. *Journal of Personality and Social Psychology*, 71(1), 83–93. <https://doi.org/10.1037/0022-3514.71.1.83>
- Brown, T.A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). Guilford Press.
- Bueno-Pacheco, A., Lima-Castro, S., Arias-Medina, P., Peña-Contreras, E., Aguilar-Sizer, M., & Cabrera-Vélez, M. (2020). Estructura factorial, invarianza y propiedades psicométricas de la Escala de Autoestima de Rosenberg en el contexto ecuatoriano [Factor Structure, Invariance and Psychometric Properties of the Rosenberg Self-Esteem Scale in the Ecuadorian Context]. *Revista Iberoamericana de Diagnóstico y Evaluación — e Avaliação Psicológica* [Ibero-American Journal of Diagnosis and Evaluation — and Psychological Assessment], 3(56), 87–99. <https://www.redalyc.org/journal/4596/459664450008/>
- Byrne, B.M. (2006). *Structural equation modeling with EQS: Basic concepts, applications, and programming*. Lawrence Erlbaum Associates.

- Cheung, G.W., & Rensvold, R.B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, 9(2), 233–255. [https://doi.org/10.1207/S15328007SEM0902\\_5](https://doi.org/10.1207/S15328007SEM0902_5)
- Cross, S.E., & Madson, L. (1997). Models of the self: Self-construals and gender. *Psychological Bulletin*, 122(1), 5–37. <https://doi.org/10.1037/0033-2909.122.1.5>
- Cross, S.E., Bacon, P.L., & Morris, M.L. (2000). The relational–interdependent self-construal and relationships. *Journal of Personality and Social Psychology*, 78(4), 791–808. <https://doi.org/10.1037/0022-3514.78.4.791>
- Diori, S. (2018). The contribution of perceived father involvement towards relational self-esteem in early adolescence. In *Proceedings of the Universitas Indonesia International Psychology Symposium for Undergraduate Research (UIPSUR 2017)* (pp. 37–45). Atlantis Press. <https://doi.org/10.2991/uipsur-17.2018.7>
- Du, H., King, R.B., & Chi, P. (2012). The development and validation of the Relational Self-Esteem Scale. *Scandinavian Journal of Psychology*, 53(3), 258–264. <https://doi.org/10.1111/j.1467-9450.2012.00946.x>
- Du, H., Li, X., Chi, P., Zhao, J., & Zhao, G. (2016). Psychometric properties of the Relational Self-Esteem Scale in a community-based sample in China. *European Journal of Psychological Assessment*, 32(4), 280–286. <https://doi.org/10.1027/1015-5759/a000320>
- Du, H., King, R.B., & Chi, P. (2017). Self-esteem and subjective well-being revisited: The roles of personal, relational, and collective self-esteem. *PLoS ONE*, 12(8), e0183958. <https://doi.org/10.1371/journal.pone.0183958>
- Fornell, C., & Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.1177/002224378101800104>
- Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Jiang, S. (2020). The effects of Instagram\* use, social comparison, and self-esteem. *Social Media + Society*, 6(2), 1–10. <https://doi.org/10.1177/2056305120912488>
- Keyes, C.L.M. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of Health and Social Behavior*, 43(2), 207–222. <https://doi.org/10.2307/3090197>
- Li, J., Liu, Y., & Song, J. (2022). The relationship between gender self-stereotyping and life satisfaction: The mediation role of relational self-esteem and personal self-esteem. *Frontiers in Psychology*, 12, 769459. <https://doi.org/10.3389/fpsyg.2021.769459>
- Luhtanen, R., & Crocker, J. (1992). A collective self-esteem scale: Self-evaluation of one's social identity. *Personality and Social Psychology Bulletin*, 18(3), 302–318. <https://doi.org/10.1177/0146167292183006>
- Markus, H.R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, 98(2), 224–253. <https://doi.org/10.1037/0033-295X.98.2.224>
- Moreta-Herrera, R., Jadán-Guerrero, J., Gordón-Villalba, P., Mayorga-Lascano, M., Shugulí-Zambrano, C., Caycho-Rodríguez, T., Cuesta-Andaluz, E., & Larzabal-Fernández, A. (2025). Satisfaction with life and suicidal ideation among Ecuadorian university students: A network analysis. *International Journal of Applied Positive Psychology*, 10, 47. <https://doi.org/10.1007/s41042-025-00242-0>
- Moreta-Herrera, R., Rodríguez-Lorenzana, A., Santillán, A., Jiménez-Borja, M., Jiménez-Mosquera, C.A., Oriol-Granado, X., & Lara-Dominguez, S. (2025). The psychometric properties of the Mental Health Continuum–Short Form (MHC–SF) for Ecuadorian teenagers. *Psychology in the Schools*, 62(8), 2554–2564. <https://doi.org/10.1002/pits.23485>

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\* Activities of Meta Platforms Inc. (Facebook and Instagram), and the X Corp. (as the successor of Twitter Inc.), are prohibited in the Russian Federation.

- Neff, K.D., & McGehee, P. (2010). Self-compassion and psychological resilience among adolescents and young adults. *Self and Identity*, 9(3), 225–240. <https://doi.org/10.1080/15298860902979307>
- Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.
- Orth, U., & Robins, R.W. (2014). The development of self-esteem. *Current Directions in Psychological Science*, 23(5), 381–387. <https://doi.org/10.1177/0963721414547414>
- Oyserman, D., Coon, H.M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses. *Psychological Bulletin*, 128(1), 3–72. <https://doi.org/10.1037/0033-2909.128.1.3>
- Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton University Press. <https://doi.org/10.1515/9781400876136>
- Tang, X., Hu, W., Zhao, X., Zhang, L., Li, Y., Chen, Q., & Yang, J. (2024). The role of personal, relational, and collective self-esteem in predicting acute salivary cortisol response and perceived stress. *Applied Psychology: Health and Well-Being*, 16(3), 824–838. <https://doi.org/10.1111/aphw.12534>
- Valle Pico, M.I., & Larzabal Fernández, A. (2022). Estrés, malestar psicológico, bienestar psicológico y satisfacción con la vida según modalidades de trabajo en madres de familia [Stress, psychological distress, psychological well-being, and life satisfaction according to work modalities in mothers]. *Ciencias Psicológicas [Psychological Sciences]*, 16(2), e2794. <https://doi.org/10.22235/cp.v16i2.2794>
- Worthington, R.L., & Whittaker, T.A. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist*, 34(6), 806–838. <https://doi.org/10.1177/0011000006288127>
- Yomtov, D., Plunkett, S.W., Sands, T., & Reid, A. (2015). Parenting and ninth graders' self-efficacy and relational self-esteem in Latino immigrant families. *Family and Consumer Sciences Research Journal*, 43(3), 269–283. <https://doi.org/10.1111/fcsr.12102>
- Zell, E., & Johansson, J.S. (2024). The association of self-esteem with health and well-being: A quantitative synthesis of 40 meta-analyses. *Social Psychological and Personality Science*, 16(4), 412–421. <https://doi.org/10.1177/19485506241229308>

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## Appendix

**Table 1**

*Original and Spanish versions of the Relational Self-Esteem Scale (RSE) Items*

<b>Item</b>	<b>English Version (Du et al., 2012)</b>	<b>Spanish Adapted Version</b>
1	I am a worthy member of my circle of friends.	Soy un miembro digno de mi círculo de amigos.
2	In general, I'm glad to be a member of my circle of friends.	En general, me alegro de ser miembro de mi círculo de amigos.
3	I feel I have much to offer to my family.	Siento que puedo tener mucho que ofrecer a mi familia.
4	I am proud of my family.	Estoy orgullosa/o de mi familia.
5	I can help my friends a lot.	Puedo ayudar mucho a mis amigas/os.
6	Overall, my circle of friends is considered to be good by others.	En general, los demás consideran que mi círculo de amigos es bueno.
7	I think my family is proud of me.	Creo que mi familia está orgullosa/o de mi.

## COGNITIVE PSYCHOLOGY

### Experimental Testing of the Affective Consequences of Nostalgia

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**Background.** The inconsistent evidence regarding nostalgia's affective outcomes suggests that its effects may not be uniform, but contingent on individual characteristics, a possibility that has received limited empirical attention.

**Objective.** To examine how induced nostalgia influences positive and negative affect, while accounting for age, gender, and overall well-being.

**Design.** A sample of 122 participants (balanced by gender and across three age groups: 20-35, 36-50, and 51-65 years) completed an Event Reflection Task to elicit either nostalgic memories or recollections of daily life events. Positive and negative affect were measured before and after the nostalgia induction and general well-being was measured after the intervention.

**Results.** Negative and ambivalent affect decreased after both experimental and control interventions. Gender and age did not moderate the effect of nostalgia induction on affect. Well-being moderated affective outcomes of nostalgia induction, with individuals higher in well-being experiencing greater increases in positive affect and greater decreases in negative and ambivalent affect (co-activation of positive and negative affect) after nostalgia induction.

**Conclusion.** The emotional impact of nostalgia appears to be independent of age or gender, but affected by individual differences in well-being. These findings help to clarify previous inconsistencies in the literature and suggest that nostalgia may be most emotionally beneficial for those already in a stable emotional state.

**Keywords:** nostalgia, emotions, positive and negative affect, ambivalent affect, well-being

## Introduction

Nostalgia is a complex socio-emotional phenomenon. Despite previous negative views on nostalgia as a “form of melancholia” (Peters, 1985), many current studies view nostalgia as “a warm, sentimental longing for the past” (Wildschut et al., 2006). Most of the studies done by the research team of Sedikides, Wildschut, and collaborators demonstrate that nostalgia enhances various aspects of psychological well-being. For example, nostalgia induction (compared to neutral memories) elicited more positive emotions, feelings of social connectedness, and more positive self-esteem (Cox et al., 2015; Reid et al., 2023; Wildschut et al., 2006), and inspired optimism (Cheung et al., 2013). Many authors view nostalgia as a coping mechanism that people can turn to during challenging life events such as migration (Wildschut & Sedikides, 2023), imprisonment (Vartanyan et al., 2024), or the loss of loved ones (Reid et al., 2021). Recently, nostalgia was shown to protect individuals from the negative effect of loneliness during the COVID-19 pandemic lockdown (Zhou et al., 2022), with individuals who engaged in nostalgic experiences exhibiting smaller declines in happiness compared to those who did not. Moreover, nostalgia proneness, a trait that characterizes how often one experiences nostalgia in everyday life, has been positively linked to the use of effective emotional and instrumental coping strategies (Batcho, 2013). Furthermore, the overall positive effect of nostalgia on affect was supported in two recent meta-analyses (Frankenbach et al., 2021; Leunissen et al., 2021). Building on this evidence, one might expect that compared to recalling an ordinary autobiographical event, nostalgia induction would lead to higher levels of positive affect (*H1*) and lower levels of negative affect (*H2*).

Although nostalgia tends to enhance positive affect, its emotional profile is not univalent. Theoretical and empirical work consistently characterize it as a bittersweet experience, simultaneously blending warmth and social connectedness with longing or loss (Wildschut et al., 2006). This duality implies that nostalgic recall may co-activate positive and negative affective systems, giving rise to a state of affective ambivalence. Supporting this, recent meta-analysis shows that nostalgic inductions increase both happiness and sadness relative to control conditions, resulting in elevated affective ambivalence (Frankenbach et al., 2021; Leunissen et al., 2021). Thus, to fully capture nostalgia’s affective consequences, researchers must move beyond isolated measures of positive and negative affect and directly assess their co-activation as affective ambivalence.

A key challenge in studying nostalgia’s affective complexity lies in how ambivalence is measured. Much of the existing literature operationalizes affective ambivalence as the minimum of ratings for “happy” and “sad” (e.g., Hepper et al., 2024), assuming that co-occurring positive and negative emotions reflect emotional conflict. While this approach sensitively captures the simultaneity of opposing feelings, it disregards their overall intensity: a participant rating both emotions as “2” receives the same ambivalence score as one rating both as “4,” despite the latter reflecting a far more intense emotional experience. To address this limitation, alternative models, such as Griffin’s Similarity-Intensity Model (Thompson et al., 1995), have been proposed. This framework defines ambivalence as a function of both the mean intensity of positive and negative affect and their similarity (*i.e.*, how close the two are in magnitude). By incorporating intensity and balance jointly, it provides a more nuanced

index of mixed affective states, better aligned with the bittersweet phenomenology of nostalgia. This view of nostalgia highlights the importance of the induction method, as different procedures may differentially engage these affective systems.

Experimental studies that tested causal links between the experience of nostalgia and affective states used a diverse array of manipulations to induce nostalgia. As recently described in a review by Wildschut and Sedikides (2024), these inductions can be made either by suggesting a vivid recall of past experiences or by presenting sensory stimuli that elucidate nostalgic feelings.

The experimental induction of a vivid recall of past experiences is achieved through an Event Reflection Task (ERT), which asks participants to recall and immerse themselves in a personally meaningful nostalgic memory following a standardized definition (“a sentimental longing for one’s past”; Zhou et al., 2022). Research indicates that the ERT elicits the most profound nostalgic feeling (Wildschut & Sedikides, 2024). However, it has been criticized for limited external validity, as recalling one’s “most nostalgic” memory on demand may not reflect how nostalgia arises spontaneously in daily life (Newman & Sachs, 2020).

An alternative approach includes presentation of sensory stimuli such as visual (pictures, photographs), gustatory (food or smells), and auditory (musical excerpts or song lyrics). Multiple studies that used this approach found that these stimuli effectively induced nostalgia (Cheung et al., 2013; Reid et al., 2015, 2023), but they do not always induce greater positive affect than control conditions (Cheung et al., 2013; Leunissen et al., 2021). Moreover, a key methodological limitation of the sensory induction manipulations lies in the difficulty of dissociating their direct affective impact from the effects specifically attributable to nostalgia induction. Consequently, observed affective responses may be confounded by characteristics inherent to the selected stimulus set (e.g., cheerful music leading both to nostalgia and positive affect; Wildschut & Sedikides, 2024). This limitation might partially explain the effect found in the meta-analysis, where the effect of nostalgia induction on emotion varied by the induction type. For example, nostalgia (compared to control) increased happiness when induced by ERT, but not by music. Further ERT and music inductions increased sadness, but if song lyrics were presented, participants reported decreased sadness (Leunissen et al., 2021).

Consequently, despite extensive experimental investigation, the nature of nostalgia’s influence on affective states remains ambiguous, specifically, whether it elicits uniformly positive, negative, or context-dependent emotional responses. This persistent empirical ambiguity may also indicate that nostalgia’s affective impact is moderated by individual characteristics.

First, age may shape how individuals experience and respond to nostalgia. Although nostalgia effects have been studied across the lifespan, the aforementioned studies were predominantly conducted on student samples (Batcho, 2013; Cheung et al., 2013; Layous et al., 2022; Reid et al., 2015, 2023; Wildschut et al., 2006). As indicated by Leunissen and colleagues (2021), out of 4,659 participants in 41 experiments included in the meta-analysis, 65% were young adults aged less than 35 years. Yet previous studies demonstrated that there are potential age differences in the content and frequency of nostalgia (Batcho, 1995), as well as in sensitivity to nostalgic triggers (Kusumi et al., 2010). Some evidence suggests that nostalgia may have

more positive and less ambivalent emotional outcomes among older compared to younger adults (Leunissen et al., 2021). Building on these findings, we hypothesized that (*H3*) the effect of nostalgia induction on affect will be moderated by age, such that older adults will exhibit greater increases in positive affect compared to younger and middle-aged adults.

Second, gender may also shape the emotional outcomes of nostalgic experience. Although not always examined, emerging evidence suggests that men and women differ in their affective responses to nostalgia. For instance, Cheung and collaborators (2013) found that nostalgia induced greater optimism in males than in females. The limited meta-analytic evidence available indicates that gender may serve as a moderator, with females reporting higher levels of sadness and affective ambivalence in nostalgia conditions compared to males (Leunissen et al., 2021). Notably, this gender difference was not observed for happiness, suggesting a complex, emotion-specific pattern of moderation that warrants further investigation. Building on this, we hypothesized that: (*H4A*) the effect of nostalgia induction on affect will be moderated by gender, such that males will exhibit greater increases in positive affect than females; (*H4B*) females will report higher levels of negative affect following nostalgia induction compared to males and (*H4C*) following nostalgia induction, females will report higher levels of affective ambivalence (the simultaneous experience of positive and negative emotions) compared to males.

Third, while some researchers consider nostalgia as a potential intervention for well-being (positive activity; Layous et al., 2022; Layous & Kurtz, 2023) and indicate that nostalgia can buffer low well-being in countries with lower life satisfaction (Hepper et al., 2024), its effects appear conditional on psychological resources. Several competing perspectives yield conflicting predictions. On the one hand, nostalgic experiences could elicit stronger positive emotions in those with higher well-being due to their greater capacity for savoring positive memories (Bryant, 2021). Accordingly, individuals with higher well-being may possess stronger savoring abilities, enabling them to derive more positive emotion from nostalgic memories rather than experiencing sadness over what has been lost. On the other hand, individuals with lower baseline well-being may derive greater benefits from nostalgia due to a compensatory mechanism, as sadness and loneliness were shown to be key triggers of nostalgia (Wildschut et al., 2006). Thus, nostalgic recollection could counteract current emotional deficits by activating comforting past experiences, potentially yielding more pronounced momentary improvements in affect compared to those with higher baseline well-being (the “low base effect”). Alternatively, emerging evidence indicates that nostalgia in daily life may have detrimental effects on well-being for individuals with pre-existing low well-being (*e.g.*, those experiencing loneliness; Newman & Sachs, 2020). This effect is especially pronounced among vulnerable populations. For instance, research conducted with youth in the Gaza Strip found that nostalgia elevated positive affect and social connectedness, but only among those with greater psychological resilience; individuals with low resilience did not experience these benefits (Abu-Rayya et al., 2025). Moreover, nostalgia was found to elevate negative affect among Syrian refugees with low psychological resilience (Wildschut et al., 2019). These complex results suggest that nostalgia’s affective benefits might only be manifest in the absence of concurrent negative life circumstances. Given this

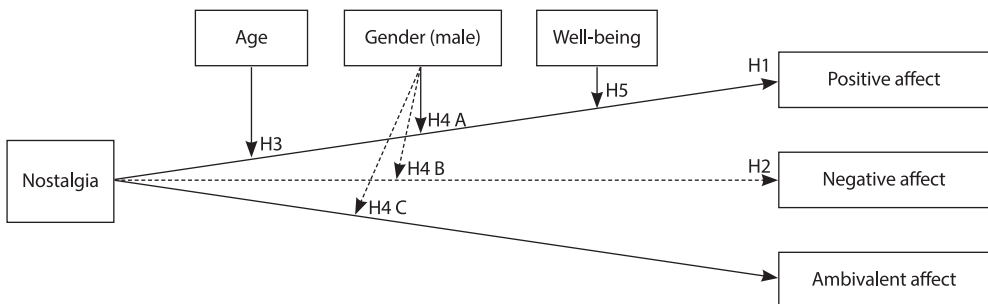
evidence, we hypothesized that (H5) the effect of nostalgia induction on affect will be moderated by baseline well-being, such that participants with higher levels of well-being will show greater increases in positive affect compared to those with lower levels of well-being.

Finally, the generalizability of findings on nostalgia remains uncertain, as the vast majority of experimental research has been conducted in WEIRD populations (Hepper et al., 2024; Leunissen et al., 2021; Santini et al., 2023) with only occasional evidence from other populations such as Syrian refugees (Wildschut et al., 2019), Gaza youth (Abu-Rayya et al., 2025), and Egyptian Nubians (Agha, 2019). Previous studies on nostalgia in Russia have mainly concerned nostalgia for the Soviet Union (White, 2010) or use of nostalgia in advertising (Holak et al., 2007). Previous research on the role of nostalgia in affective regulation among Russian populations is limited to a small number of observational studies conducted by our group, which positioned nostalgia as a resource for resilience (Bartseva et al., 2025; Vartanyan et al., 2024), and a recent cross-cultural study (Hepper et al., 2024). The latter study identified Russia as one of the least nostalgic or nostalgia-neutral countries, underscoring the need for further empirical inquiry into the function and experience of nostalgia in this cultural context.

The current study addresses these questions in a setting of heightened relevance: the contemporary Russian socio-cultural landscape, marked by rapid change and uncertainty. In such conditions, internally accessible strategies like nostalgia may offer a vital, low-cost tool for emotional regulation. By experimentally testing how nostalgia influences positive affect, negative affect, and affective ambivalence in a demographically diverse Russian-speaking sample, while examining age, gender, and baseline well-being as key moderators, we aim to clarify for whom and under what conditions nostalgia functions as a psychological resource.

Theoretically, this work contributes to cross-cultural models of emotion regulation by testing whether nostalgia's affective mechanisms are universally robust or culturally contingent. Practically, it informs the potential development of evidence-based, self-administered interventions for non-clinical populations.

The present study tests the conceptual model depicted in *Figure 1*.



*Figure 1.* Conceptual model of moderated effects of nostalgia induction on affective outcomes

*Note.* Solid lines indicate a positive effect (i.e., higher levels of the moderator are associated with an increase in affective outcome); dashed lines indicate a negative effect (i.e., higher levels of the moderator are associated with a decrease in the affective outcome).

## Methods

### Participants

The sample included 126 individuals, both men and women, distributed approximately equally across three age groups. After exclusion of individuals who did not experience nostalgia in the nostalgia induction condition (*see Manipulation Check for details*) and participants out of the intended age range, the final sample consisted of 122 people, 64 females,  $M_{\text{age}} = 38.63$ ,  $SD = 14.13$  (*see Table 1* for  $N$ s divided by gender and age group).

**Table 1**

*Age and Gender Distribution of the Resulting Sample*

	20–35 years	36–50 years	51–65 years
Men	23	20	15
Women	23	22	19

### Procedure

Data collection was conducted online by a team of 16 trained interviewers. All interviewers completed a structured training session on the study protocol. They were provided with verbatim scripts for both the nostalgia and neutral induction conditions to ensure consistent delivery. Each interviewer followed a standardized protocol to ensure consistency in the administration of questionnaires and experimental procedures. The research team used quota sampling to ensure balanced representation across gender and age categories, using a snowball sampling technique, starting from research team close contacts (friends and relatives).

Participants completed all tasks and questionnaires during video calls. After providing informed consent, participants were randomly assigned to either the experimental (nostalgia) group or the control (non-nostalgic memory) group. An audio recording was made during the study, to which the participants gave their consent.

All participants first completed the Positive and Negative Affect Schedule (PANAS) to assess their baseline emotional state. Following this, participants in the experimental group were asked to recall and describe a nostalgic memory, while those in the control group were instructed to describe a routine event from the past few days.

To ensure manipulation effectiveness, participants answered control questions designed to verify whether those in the nostalgia group experienced nostalgic feelings (*e.g.*, “I am experiencing nostalgic feelings right now”).

After the experimental manipulation, all participants completed the PANAS again to measure changes in their emotional state. They also completed the WHO-5 Well-Being Index to assess their general level of well-being over the past two weeks. Finally, participants provided demographic information including their age and gender.

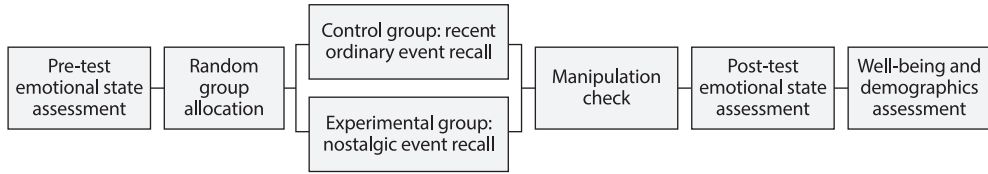


Figure 2. Schematic procedure of the experiment

The entire procedure took approximately 30–45 minutes to complete. Throughout the study, trained interviewers were available online to provide guidance and answer any questions participants might have had about the procedure. Figure 2 shows the schematic procedure of the experiment.

## Measures

### *Positive and Negative Affect Schedule (PANAS).*

The Russian adaptation (Osin, 2012) of the PANAS (Watson et al., 1988) was used to assess participants' emotional state before and after the experimental manipulation. The scale consists of 20 items, with two 10-item subscales assessing positive affect (PA; “Interested”, “Excited”) and negative affect (NA; “Depressed”, “Upset”). Participants rated the extent to which they experienced each emotion on a 5-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). The Russian version of PANAS has demonstrated good reliability and validity, consistent with the original English version (Osin, 2012). In the current study, the internal consistency was excellent for both subscales at both time points: negative affect pre-test (Cronbach's  $\alpha = .915$ ), and post-test (Cronbach's  $\alpha = .884$ ), positive affect pre-test (Cronbach's  $\alpha = .835$ ), and post-test (Cronbach's  $\alpha = .889$ ).

In addition to analyzing PA and NA independently, we computed a composite affective ambivalence (AA) score to capture the simultaneous co-activation of positive and negative emotional systems. This score was calculated using Griffin's Similarity-Intensity Model of Ambivalence (Thompson et al., 1995) according to the following formula:  $Ambivalence = [ (PA + NA) / 2 ] - |PA - NA| + C$ , where PA and NA represent the summed scores from the PANAS subscales,  $|PA - NA|$  is the absolute difference between them, and  $C = 10$  was added to ensure non-negative values. This index yields higher scores only when both positive and negative affect are high in intensity and similar in magnitude, capturing strong, balanced mixed affect—the theoretical hallmark of nostalgia's bittersweet quality. Unlike the minimum-score method (e.g., minimal value for “happy” and “sad”; Hepper et al., 2024), which reflects co-occurrence of specific emotions but ignores overall intensity, the Griffin model quantifies ambivalence at the level of broad affective dimensions. We selected this approach because our hypotheses concerned the generalized co-activation of positive and negative affective systems—and how this co-activation is moderated by stable individual differences (e.g., well-being)—rather than the experience of a single emotion pair. AA scores were computed separately for the pre- and post-manipulation time points.

### *World Health Organization-Five Well-Being Index (WHO-5)*

The WHO-5 (The World Health Organization- Five Well-Being Index, n.d.) was used to measure participants' general well-being. This 5-item questionnaire asks participants to rate how they have been feeling over the last two weeks on a 6-point Likert scale from 0 (at no time) to 5 (all of the time). Example item: "I have felt cheerful and in good spirits". The raw score, ranging from 0 to 25, is multiplied by 4 to give the final score, with 0 representing the worst well-being and 100 the best well-being.

The official Russian-language version of the WHO-5 scale was developed by WHO. The scale has good internal consistency: Cronbach's  $\alpha$  coefficients ranging from .82 to .95. In the present study, the WHO-5 demonstrated good internal consistency (Cronbach's  $\alpha = .862$ ).

The WHO-5 was administered after the experimental manipulation. Although a baseline assessment would be ideal for establishing temporal precedence, we opted to administer it post-intervention to minimize participant burden and reduce the risk of testing fatigue or carryover effect, which could compromise response quality on our primary affect measures. Critically, the WHO-5 is explicitly designed as a retrospective measure of well-being over the preceding two weeks, thereby capturing a relatively stable, trait-like construct that largely predates the experimental session. Taken together, these psychometric properties justify treating post-session WHO-5 scores as a reasonable proxy for pre-intervention well-being.

### *Nostalgia Manipulation*

Participants in the experimental group performed the Event Reflection Task (Wildschut & Sedikides, 2024) and were asked to recall and describe a nostalgic event from their past, while those in the control group were instructed to recall and describe a routine event from the past few days. The exact instructions for the experimental group were as follows: "Now you are asked to complete a task related to a nostalgic memory. Nostalgia is a 'sentimental longing for the past' — for example, for a childhood camp, school friends, or family trips. You will need to recall an event from the past that evokes the greatest nostalgia in you. Take a few minutes to think about this nostalgic event, immerse yourself in it and the feelings it evokes in you. Then tell me about this event as much as you consider necessary."

For the control group, the instructions were: "You will need to complete a task related to your memories. Please recall and describe what happened to you three days ago. Describe where you were and what you were doing during that day, what emotions you experienced. You can think about it a little and then tell as much as you consider necessary."

### *Manipulation Check*

To ensure the effectiveness of the nostalgia manipulation, participants in both the experimental and control groups completed a three-item manipulation check immediately after the recall task, adopted from a previous study (Cheung et al., 2013). All items were rated on a 5-point Likert scale (1 = not at all to 5 = very much). The items were: "I am experiencing nostalgic feelings right now"; "I have nostalgic thoughts

right now”; and “I feel nostalgia at this moment.” Internal consistency for the three items in the current study was excellent (Cronbach’s  $\alpha = .9$ )

Participants in the nostalgia condition were required to demonstrate a clear subjective experience of nostalgia. To ensure this, we applied an exclusion criterion based on the scale’s face validity: a total score below 9 (out of a maximum of 15) indicates that the participant responded with “3 = neutral” or lower (*i.e.*, not at all, slightly, or moderately) on at least one of the three key items, thereby failing to affirm the presence of nostalgic feeling, thought, or experience. This threshold was chosen because a score of 9 corresponds to the lowest total possible when all three items are rated at the midpoint (“neutral”); any lower total implies active disagreement or absence of the nostalgic state. Following this criterion, three participants from the nostalgia condition were excluded, ensuring that all retained participants reported at least moderate agreement across all items measuring state nostalgia.

The final analytic sample showed a significant difference in manipulation check scores between conditions:  $M = 12.87$  ( $SD = 1.86$ ) in the nostalgia group versus  $M = 9.68$  ( $SD = 3.39$ ) in the control group, *Mann-Whitney*  $U = 2917$ ,  $p < .001$ , confirming the success of the experimental manipulation.

### **Statistical Approach**

To examine the effects of measurement time (pre- vs post-manipulation), experimental condition (nostalgia induction vs. neutral memory), and individual differences (age, gender, well-being) on affect (PA, NA, and AA), we fitted a linear mixed-effects model using the *lmer* function from the *lme4* package (version 1.1.35.3; Bates et al., 2014) in RStudio (R version 4.3.3). The model included fixed effects for Time (within-participant), Condition (between-participants), and their interaction, as well as interactions between Condition and individual difference variables (age, gender, and well-being). These interactions tested whether the effect of experimental condition on affect varied as a function of these participant characteristics.

A random intercept for participant ID was included to account for repeated measures within individuals and to account for baseline differences between individuals. The model was estimated using restricted maximum likelihood (REML).

All continuous predictors (age, WHO5) were mean-centered prior to analysis to facilitate interpretation of interaction terms. Model assumptions (normality and homoscedasticity of residuals) were checked visually using diagnostic plots and were found to be reasonably met.

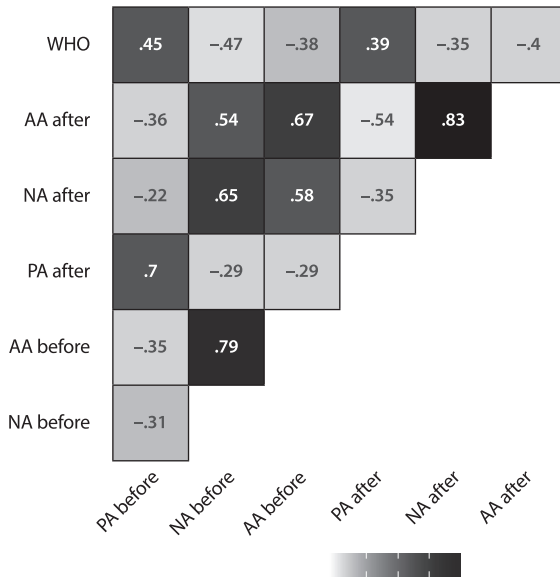
### **Results**

Descriptive statistics for all study variables in the two groups are available in *Table 2*. Mann-Whitney *U* tests were conducted to compare the control and experimental groups. The results indicated greater pre-intervention positive affect in the control group compared to the nostalgia induction group, with a small effect size (rank-biserial  $r = -.24$ , 95% CI  $[-.42, -.04]$ ). This baseline difference is not a confound for testing the intervention effect, as our primary models use each participant as their own control (via the random intercept) and tests the change in affect from pre- to post-intervention.

**Table 2**  
*Descriptive Statistics of the Study Variables in Two Groups*

Variable	Control condition (N=59)			Nostalgia condition (N=63)			Group comparison	
	Mean	SD	Min-Max	Mean	SD	Min-Max	Mann-Whitney U	p
Negative Affect (Pre-test)	16.39	6.51	10–41	17.48	8.12	10–45	1896	.85
Negative Affect (Post-test)	14.34	5.33	10–32	15.11	6.21	10–36	1947	.65
Positive Affect (Pre-test)	32.07	5.92	15–46	29.52	6.15	15–47	1409.5	.02
Positive Affect (Post-test)	31.97	6.82	15–48	30.65	7.14	11–47	1668.5	.33
Ambivalent affect (Pre-test)	17.26	8.36	3.5–41	18.88	9.24	5.5–40	2016	.42
Ambivalent affect (Post-test)	15.02	8.54	1–42	16.01	8.70	2.5–34	2001.5	.46
Well-being (WHO-5)	51.25	19.83	0–80	48.44	20.19	0–88	1717.5	.47

Further, we inspected correlation coefficients between study variables (*Figure 3*). All correlations were significant at the  $p < .05$  level. Well-being showed moderate correlations with measures of affect, while the strongest relationships were between pre- and post-intervention scores for positive, negative, and ambivalent affect.



*Figure 3.* Correlations between study variables

**Positive Affect**

To explore the relationship between nostalgia, affect, and individual differences, linear mixed-effect regression analysis was conducted for positive affect (Table 3).

**Table 3**

*Results of the Mixed-Effect Linear Regression for Positive Affect after Memory Induction*

Predictor	B	SE	$\beta$	95% CI	<i>p</i>
(Intercept)	28.75	.99	-.34	26.8–30.71	<.001
Time (after)	1.17	.85	.18	-.52–2.85	.17
Condition (ordinary)	2.4	1.54	.36	-.64–5.43	.12
Time (after) × Condition (ordinary)	-1.65	1.33	-.25	-4.27–.97	.21
Time (before) × Condition (nostalgia) × Age	-.02	.05	-.04	-.12–.08	.73
Time (after) × Condition (nostalgia) × Age	-.05	.05	-.12	-.16–.05	.29
Time (before) × Condition (ordinary) × Age	-.01	.06	-.02	-.13–.11	.86
Time (after) × Condition (ordinary) × Age	-.08	.06	-.17	-.2–.04	.19
Time (before) × Condition (nostalgia) × Gender (male)	2.17	1.54	.33	-.86–5.2	.16
Time (after) × Condition (nostalgia) × Gender (male)	2.07	1.54	.31	-.96–5.1	.18
Time (before) × Condition (ordinary) × Gender (male)	1.28	1.63	.19	-1.94–4.49	.43
Time (after) × Condition (ordinary) × Gender (male)	2.13	1.63	.32	-1.09–5.34	.19
Time (before) × Condition (nostalgia) × WHO	.1	.04	.31	.03–.18	.007
Time (after) × Condition (nostalgia) × WHO	.12	.04	.37	.05–.2	.001
Time (before) × Condition (ordinary) × WHO	.16	.04	.48	.08–.24	<.001
Time (after) × Condition (ordinary) × WHO	.14	.04	.43	.06–.22	<.001
<b>Random Effects</b>					
$\sigma^2$					13.24
$\tau_{00 \text{ ID}}$					22.38
ICC					.63
$N_{\text{ID}}$					122
Observations					244
Marginal $R^2$ / Conditional $R^2$					.216 / .708
AIC					1.545.281

As shown in Table 3, fixed effects explained around 22% of the variance in PA (marginal  $R^2$ ), while fixed and random effects together explained 70% (conditional  $R^2$ ), indicating substantial individual-level variability.

The main effect of time (pre- to post-experimental manipulation) was non-significant, suggesting no significant change in PA in both conditions. The main effect of condition (nostalgic vs. control) was also non-significant, suggesting no overall difference in PA between groups. The interaction between time and condition was non-significant, thus rejecting *H1*.

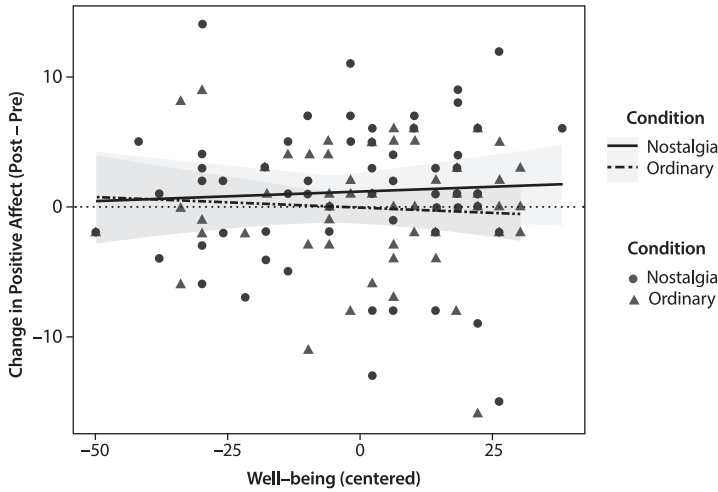


Figure 4. Well-being predicts PA change after ordinary memory and induced nostalgia

Among moderators, only significant time  $\times$  condition  $\times$  WHO-5 interactions occurred, revealing that well-being moderates the effect of condition on change in PA (Figure 4). Specifically, the positive significant coefficient indicates that the effect of the nostalgia induction on positive affect over time was stronger for individuals with higher initial well-being: for every one-unit increase in WHO-5 score, the nostalgia intervention produced an additional 0.12-unit increase in positive affect from pre-test to post-test, thus partially supporting *H5*. Well-being was also associated with changes in PA in the control group.

Figure 4 visualizes the effect of interaction between experimental condition and well-being on changes in PA. The horizontal dashed line represents zero change (Post – Pre = 0), serving as a reference for interpreting the direction of effects. Among participants with lower baseline well-being, PA change scores clustered around zero in both the nostalgia (solid line) and control (dashed line) conditions. However, at higher levels of well-being, the conditions diverged: participants in the nostalgia condition showed a slight increase in PA (regression line above zero), whereas those in the control condition remained near the no-change threshold.

This asymmetry in the control group (improvement at low baseline and decline at high baseline) is consistent with regression to the mean (RTM), a statistical tendency for extreme scores to revert toward the mean on retest. To test this, we correlated pre-test PA with PA change scores (Post – Pre) within each condition. RTM would be manifest as a strong negative correlation. However, the results showed only a small, significant correlation in the nostalgia condition ( $r = -.25, p = .038$ ) and a non-significant correlation in the control condition ( $r = -.17, p = .197$ ). These modest effects suggest that RTM played, at most, a minor role of the observed patterns.

No significant three-way interactions were found for age or gender, failing to support *H3* and *H4A*.

Finally, as a robustness check, we re-estimated the model using centered self-reported nostalgia scores (from the manipulation check) in place of the experimental condition, including all participants. This analysis yielded no significant main, interaction, or mediation effects, reinforcing that the observed moderation by well-being is tied to experimental assignment, not subjective nostalgia intensity.

### **Negative Affect**

As shown in *Table 4*, for NA, fixed effects explained 27% of the variance (marginal  $R^2$ ), while fixed and random effects together explained 68% (conditional  $R^2$ ), again indicating substantial individual-level variability.

**Table 4**

*Results of the Mixed-Effect Linear Regression for Negative Affect after Memory Induction*

Predictor	B	SE	$\beta$	95% CI	P
(Intercept)	19.14	.97	.49	17.23 – 21.05	<.001
Time (after)	-3.03	.92	-.45	-4.83 – -1.22	.001
Condition (ordinary)	-3.88	1.51	-.58	-6.85 – -.9	.011
Time (after) × Condition (ordinary)	1.72	1.43	.26	-1.08 – 4.53	.23
Time (before) × Condition (nostalgia) × Age	-.1	.05	-.2	-.2 – .01	.06
Time (after) × Condition (nostalgia) × Age	-.08	.05	-.16	-.18 – .03	.14
Time (before) × Condition (ordinary) × Age	.03	.06	.06	-.09 – .14	.62
Time (after) × Condition (ordinary) × Age	-.05	.06	-.11	-.17 – .06	.36
Time (before) × Condition (nostalgia) × Gender (male)	-4.63	1.51	-.69	-7.6 – -1.66	.002
Time (after) × Condition (nostalgia) × Gender (male)	-2.87	1.51	-.43	-5.84 – .1	.06
Time (before) × Condition (ordinary) × Gender (male)	2.56	1.6	.39	-.56 – 5.74	.11
Time (after) × Condition (ordinary) × Gender (male)	1.03	1.6	.15	-2.12 – 4.18	.52
Time (before) × Condition (nostalgia) × WHO	-.13	.04	-.38	-.2 – -.06	.001
Time (after) × Condition (nostalgia) × WHO	-.09	.04	-.28	-.17 – -.02	.012
Time (before) × Condition (ordinary) × WHO	-.21	.04	-.61	-.28 – -.13	<.001
Time (after) × Condition (ordinary) × WHO	-.09	.04	-.27	-.17 – -.01	.02
<b>Random Effects</b>					
$\sigma^2$					15.24
$\tau_{00 \text{ ID}}$					18.99
ICC					.55
$N_{\text{ID}}$					122
Observations					244
Marginal $R^2$ / Conditional $R^2$					.273 / .676
AIC					1.551.565

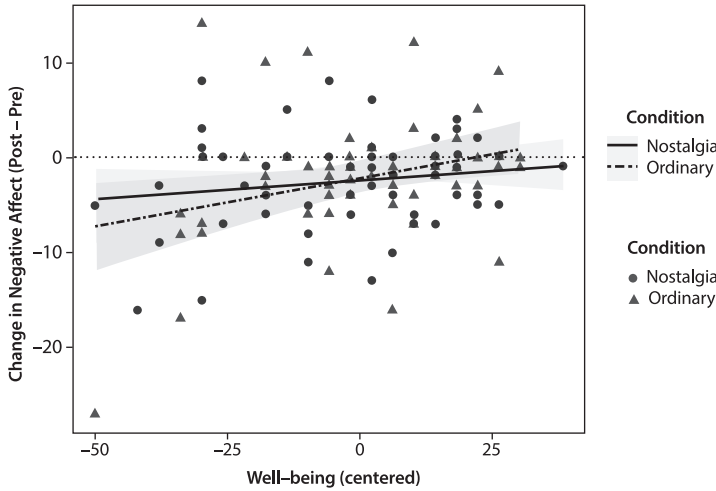


Figure 5. Well-being predicts NA change after ordinary memory and induced nostalgia

NA scores decreased significantly from pre- to post-manipulation across both conditions, but the condition  $\times$  time interaction was non-significant, thus rejecting *H2*. At baseline, those in the control condition reported significantly lower NA scores compared to the nostalgic condition, suggesting that individuals in the nostalgic condition may have started with greater emotional distress.

There was a moderation effect of gender. Males in the nostalgia condition reported lower NA than females before the intervention, but not after nostalgia induction.

Finally, well-being significantly moderated the effect of condition on NA change ( $\beta = -.28, p = .012$ ), partially supporting *H5*. Figure 5 illustrates this pattern. Values below the zero-change line indicate a reduction in NA. Among participants with lower well-being, both conditions produced reductions in NA (regression lines below zero), with the control condition showing larger decrease. However, at higher levels of well-being, the patterns diverged: the nostalgia condition stabilized NA (line approaching zero), whereas the control condition was associated with a slight increase in NA (line crossing above zero).

Crucially, the well-being  $\times$  condition interaction was not significant, indicating that the moderating role of well-being did not differ meaningfully between conditions. In other words, higher well-being was associated with greater NA reduction, but this effect was not uniquely enhanced by nostalgia.

As a robustness check, we re-estimated the model using centered self-reported nostalgia scores instead of experimental condition. In this analysis, nostalgia intensity was a significant positive predictor of NA ( $\beta = .73, p = .007$ ), indicating that participants who felt more nostalgic also reported higher overall levels of negative affect. However, the time  $\times$  nostalgia interaction was non-significant, confirming that change in NA was not driven by subjective nostalgia intensity. A significant nostalgia  $\times$  well-being interaction at pre-test (higher well-being linked to lower NA

among highly nostalgic individuals) disappeared post-test, further suggesting that well-being shaped baseline affective states but not intervention-related change.

### **Ambivalent Affect**

As shown in Table 5, for AA, fixed effects explained 22% of the variance (marginal  $R^2$ ), while fixed and random effects together explained 68% (conditional  $R^2$ ), again indicating substantial individual-level variability. AA scores decreased significantly from pre- to post-intervention across both conditions. The conditions did not differ in ambivalent affect.

**Table 5**

*Results of the Mixed-Effect Linear Regression for Ambivalent Affect after Memory Induction*

Predictor	B	SE	$\beta$	95% CI	<i>p</i>
(Intercept)	20.53	1.32	.42	17.93–23.13	<.001
Time (after)	-3.45	1.19	-.39	-5.8–-1.1	.004
Condition (ordinary)	-3.11	2.05	-.35	-7.16–.93	.13
Time (after) × Condition (ordinary)	1.67	1.86	.19	-1.98–5.33	.37
Time (before) × Condition (nostalgia) × Age	-.1	.07	-.16	-.24–.03	.14
Time (after) × Condition (nostalgia) × Age	-.1	.07	-.16	-.24–.04	.15
Time (before) × Condition (ordinary) × Age	-.04	.08	-.07	-.2–.11	.58
Time (after) × Condition (ordinary) × Age	-.06	.08	-.09	-.21–.1	.48
Time (before) × Condition (nostalgia) × Gender (male)	-4.43	2.05	-.5	-8.47–-.39	.03
Time (after) × Condition (nostalgia) × Gender (male)	-3.24	2.05	-.37	-7.27–.8	.11
Time (before) × Condition (ordinary) × Gender (male)	.42	2.17	.05	-3.86–4.71	.85
Time (after) × Condition (ordinary) × Gender (male)	-.58	2.17	-.07	-4.86–3.71	.79
Time (before) × Condition (nostalgia) × WHO	-.07	.05	-.17	-.17–.03	.15
Time (after) × Condition (nostalgia) × WHO	-.14	.05	-.31	-.24–-.04	.008
Time (before) × Condition (ordinary) × WHO	-.24	.05	-.55	-.35–-.13	<.001
Time (after) × Condition (ordinary) × WHO	-.18	.05	-.42	-.29–-.08	.001
<b>Random Effects</b>					
$\sigma^2$					25.85
$\tau_{00 ID}$					37.38
ICC					.59
$N_{ID}$					122
Observations					244
Marginal $R^2$ / Conditional $R^2$					.221 / .682
AIC					1.684.351

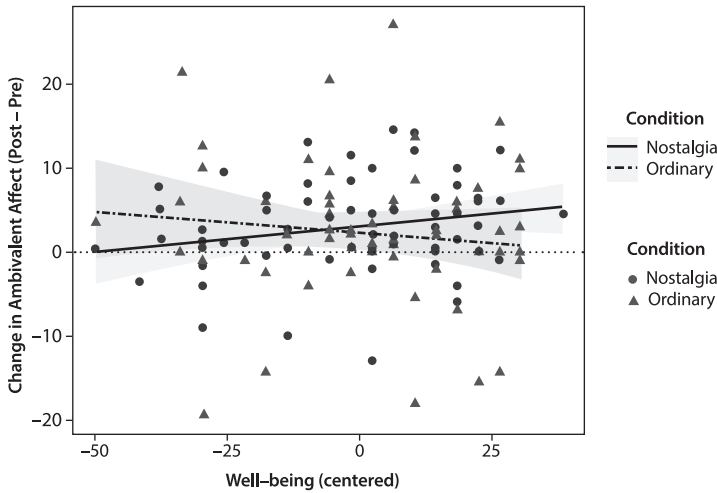


Figure 6. Well-being predicts AA change after ordinary memory and induced nostalgia

Male participants in the nostalgia condition reported lower AA before the intervention. No difference in AA between males and females was found after nostalgia induction.

Well-being significantly moderated the effect of condition on AA change (supporting H5). As Figure 6 shows, the pattern diverged meaningfully across conditions. Among participants with lower well-being, the control condition was associated with an increase in AA (dashed line above zero), whereas the nostalgia condition produced no reliable change (solid line near zero). Conversely, at higher levels of well-being, this pattern reversed: nostalgia recall was linked to increased AA (solid line rising above zero), while the control condition approached stability (dashed line converging on zero).

In the control condition (dashed line), the pattern was qualitatively different: individuals with low well-being showed a small reduction in AA, but those with high well-being actually exhibited a slight increase in ambivalence after recalling an ordinary memory. This reversal implies that neutral autobiographical reflection may disrupt emotional clarity among those who typically experience low ambivalence.

As a robustness check, we re-estimated the model using centered self-reported nostalgia scores instead of experimental condition. The main effect of time remained significant, but nostalgia intensity was not associated with higher baseline AA, and the time  $\times$  nostalgia interaction was non-significant. Moreover, no higher-order interactions with well-being, age, or gender reached significance.

## Discussion

The present study examined the emotional impact of nostalgia induction compared to a neutral memory recall condition, with a focus on changes in positive affect (PA), negative affect (NA), and affective ambivalence (AA). We also examined

whether these effects were moderated by age, gender, and well-being (as measured by WHO-5).

*H1* and *H2* predicted that participants in the nostalgia condition would experience a greater increase in positive affect and greater decrease in negative affect compared to the daily recollection of life events. Contrary to previous literature (Frankenbach et al., 2021; Leunissen et al., 2021) which has documented overall boosts in positive affect following nostalgic recall, the nostalgia induction did not lead to increases in positive affect or decreases in negative affect when compared to the control condition in our sample. While this could reflect nostalgia's bittersweet nature (Batcho, 2013) — where positive emotions coexist with loss — the absence of changes in ambivalence scores rules out this explanation and casts some doubts on the previously suggested overall positivity of nostalgic experiences (Frankenbach et al., 2021; Leunissen et al., 2021), especially induced under controlled conditions (Newman et al., 2020). Our study's online format (data were collected in 2024) created a unique methodological context. It lacked the high degree of control and potential stress of a laboratory environment, yet the requirement to recollect a nostalgic memory on demand remained an artificial task, one that does not fully mirror the contextual nature of nostalgic experiences in daily life. Therefore, our findings contribute to a more critical perspective, indicating that nostalgia's positive effects are not universal and may be dependent on the context of its induction.

An important context for interpreting the ambivalence findings is the baseline affective profile of our non-clinical sample, where positive affect scores were significantly higher than negative affect scores across conditions. This pattern is typical in community samples and does not invalidate the ambivalence measure. On the contrary, the Griffin formula is mathematically sensitive to this asymmetry; it inherently provides low ambivalence scores when one affect system strongly dominates and higher scores only when both systems are concurrently active. Therefore, the observed experimental effects on AA reflect meaningful changes in this mixed affective state, supporting the hypothesis that nostalgia specifically engages and then modulates emotional conflict.

The present study revealed a reduction in negative and ambivalent affect not only in the nostalgia condition but also in the control condition. This finding might have several potential explanations. First, the core procedure of recalling an autobiographical memory, irrespective of its specific emotional valence, may in itself possess regulatory power. This act of reflection could promote a state of mindfulness and emotional processing, leading to a generalized reduction in negative affect. Alternatively, it is possible that the memories that participants self-selected as "ordinary" were, in fact, neutral-positive or otherwise personally meaningful, thereby producing a similar, albeit potentially weaker, regulatory effect compared to nostalgia. To elucidate the nature of this effect, future research should directly compare the emotional, thematic, and linguistic content of nostalgic and ordinary memories. Such an analysis will be crucial for pinpointing the unique components that differentiate nostalgia from other forms of positive autobiographical thought.

This result could also be explained by slightly higher initial negative affect in the nostalgia condition group, meaning that there was more negative affect to reduce in the nostalgia group compared to the neutral memory group, which nostalgia appar-

ently failed to overcome. Studies that allow for better balance between groups in their initial levels of negative affect (and other traits) or studies that implement negative emotions induction (e.g., with a sad video) before nostalgia induction, to unify starting ground for both groups, are needed in order to investigate this effect further.

The Russian context adds further nuance. Hepper and collaborators (2024) identified Russia as a “nostalgia-neutral” culture, and our sample may engage with nostalgia differently than WEIRD populations. The lack of universal positivity may reflect this cultural backdrop, where nostalgic reflection on the past does not automatically invoke comfort, but may evoke ambivalence about national or personal history. Thus, our findings caution against universalizing Western models of nostalgia as a purely adaptive resource.

Although the main effects of nostalgia were limited, we identified well-being as a potential moderator of its effects, supporting *H5*. Specifically, well-being significantly moderated the effect of intervention on positive affect, with participants higher in well-being showing greater positive affect after nostalgia induction. This interaction suggests that nostalgia may have emotional benefits, but primarily for individuals already at a higher baseline level of well-being. The same pattern was found for negative affect: individuals with higher well-being were somewhat buffered against negative emotional responses after nostalgia induction. Individuals with higher well-being also demonstrated higher affective ambivalence after nostalgia induction. These results align with prior research highlighting that pre-existing psychological resources are a critical moderator of autobiographical memory’s impact on mood. For instance, individuals with depression derive less positive affect from happy memories and experience intensified negative affect from sad memories (Kim & Yoon, 2020). Similarly, the beneficial effects of nostalgia were found to be contingent on attachment security; only participants with low insecurity showed mood improvements, while those with high insecurity did not (Cavanagh et al., 2015).

Together these findings align with the vantage sensitivity framework (De Villiers et al., 2018), which posits that individuals vary in their responsiveness to positive interventions due to differences in environmental sensitivity. The moderation effect of well-being suggests that pre-existing psychological resources may enhance sensitivity to positive stimuli described in the model. Specifically, those with higher well-being exhibited amplified positive affect and affective ambivalence, reduced negative affect after nostalgia, consistent with the idea that they are better equipped to extract emotional value from positive experiences. Conversely, individuals with lower well-being showed muted responses, possibly reflecting lower sensitivity to the intervention’s benefits. This pattern underscores that nostalgia’s efficacy is not uniform, but hinges on an individual’s capacity to process and benefit from positive emotional cues—a core tenet of vantage sensitivity. Future research could explicitly measure environmental sensitivity to test whether it accounts for the observed well-being moderation.

Notably, our findings are more consistent with the vantage sensitivity framework than with the differential susceptibility hypothesis (Belsky & Pluess, 2009). While differential susceptibility posits that certain individuals are more responsive to both positive and negative environmental influences, our results revealed an asymmetric

pattern: individuals with higher baseline well-being derived greater emotional benefits from nostalgia induction, whereas those with lower well-being showed neither heightened gains nor increased vulnerability. This suggests that well-being functions primarily as a facilitator of positive intervention effects rather than a broad marker of environmental susceptibility. Such a distinction underscores the importance of considering individual differences in psychological resources when designing and implementing emotion-focused interventions.

In line with previous findings (Santini et al., 2023), there was no consistent evidence supporting H3, which predicted that older adults would benefit more in terms of positive affect. Age did not significantly moderate the effect of nostalgia on changes in positive, negative or ambivalent affect. This suggests that while nostalgia has been found to be more prominent for older adults (Batcho, 1995; Kusumi et al., 2010), its capacity to enhance positive emotions may be comparable across age groups in the context of this brief experimental induction.

Similarly, *H4A-H4C*, predicting that males would show different patterns of positive, negative, and ambivalent affect than females, was not supported by the data. Gender did not significantly moderate changes in positive, negative or ambivalence affect after nostalgia induction.

Together these findings suggest that nostalgia's emotional effects are complex and conditional. While it does not universally boost positive affect or reduce negative affect, its benefits become more evident when considering individual differences. Well-being emerged as a potential moderator across all affective domains, suggesting that nostalgia functions more effectively as an emotional resource when individuals already possess adequate psychological resources. Gender and age did not significantly shape emotional changes from pre- to post-intervention after a brief nostalgia induction.

Practically, these results suggest that nostalgia-based interventions might be most effective for individuals with relatively high baseline well-being. Future research should aim to identify the thresholds of well-being at which nostalgia is most safely and effectively applied.

## Conclusion

In sum, the present study found limited overall emotional benefits of nostalgia induction but revealed potential moderating effects of well-being. Our findings suggest that nostalgia may function less as a universal mood-enhancer and more as a personalized regulatory tool whose effectiveness depends on the individual's psychological profile. For example, individuals with higher well-being may have more emotional benefit or resilience from nostalgic reflection, while individuals with lower well-being might experience greater ambivalence or limited gains.

These results have important theoretical implications for understanding the role of nostalgic experiences in the formation of emotional states. The results of the work may contribute to the understanding of the regulatory function of nostalgia and its role in coping strategies, and contribute to the development of mental health support strategies based on the use of nostalgia as a resource for resilience.

## Limitations

A key methodological limitation of this study is that well-being, assessed using the WHO-5, was measured after the experimental manipulation rather than at baseline. Although the WHO-5 is explicitly designed to capture relatively stable subjective well-being over the preceding two weeks and has demonstrated high test–retest reliability over a 7-day interval (Yang et al., 2023), we cannot entirely rule out the possibility that the nostalgia induction influenced participants' retrospective well-being reports. Such reverse causality would threaten the internal validity of interpreting well-being as a pre-existing moderator of intervention effects. To address this concern empirically, we conducted a supplemental analysis comparing post-intervention WHO-5 scores between the nostalgia and control conditions. The absence of a significant difference between groups ( $t(120.46) = -.712, p = .48$ ) provides preliminary evidence that the manipulation did not systematically alter well-being ratings, supporting our interpretation of WHO-5 as a proxy for pre-existing differences. Nevertheless, to definitively establish temporal precedence and rule out confounding, future studies should administer the WHO-5 prior to any experimental intervention.

Second, although our sample size ( $N = 122$ ) was sufficient to detect medium-to-large main effects consistent with prior nostalgia research, it provided limited power to detect smaller or more complex effects, such as three-way interactions. A post-hoc sensitivity analysis indicated that we could reliably detect interactions explaining  $\geq 7\%$  of additional variance ( $\eta^2_p \geq .07$ ), a threshold met by our well-being moderation effects. However, for non-significant interactions (e.g., age, gender), confidence intervals were wide and included both null and substantively meaningful effects. Thus, these null findings should be interpreted as inconclusive, not as evidence of absence. Furthermore, the use of quota and snowball sampling methods constrains the generalizability of the findings. While quota sampling ensured diversity on key demographics, and snowball sampling aided recruitment, these non-probability methods introduce the potential for selection bias and reduce external validity. The sample may not fully represent the broader population, as it could over-represent certain social networks or community groups. Future research aimed specifically at investigating these higher-order interactions may require larger randomly selected samples to achieve adequate statistical power.

Third, our design did not account for potential interviewer effects. Sixteen different interviewers conducted the sessions, and we did not record interviewer IDs, preventing us from statistically modelling this source of clustering (e.g., with a random intercept for interviewer). While we implemented rigorous procedural controls (including standardized scripts, training, and supervised practice, to ensure consistent delivery), we cannot rule out that unmeasured variance between interviewers influenced the results. This may affect the generalizability and precision of our effect estimates. Future research using interviewer-administered interventions must record interviewer identifiers and include them as a random factor in the statistical model to partition and control for this variance, thereby strengthening internal validity.

Fourth, we relied on the Event Reflection Task (ERT) for nostalgia induction, a method that has been critiqued for potential constraints on external validity (Newman et al., 2020). Further, the use of a brief, one-time induction may not have been strong enough to elicit large emotional changes, especially for those with low engagement or low baseline nostalgia proneness. To address these concerns, future research should pursue two key directions: (1) replication of the present findings using alternative nostalgia induction techniques (e.g., sensory stimuli such as visual or auditory cues) and (2) direct empirical comparisons between the ERT and other induction methods to assess their relative efficacy in eliciting nostalgic intensity and influence affective states. Research that assesses whether turning to nostalgia repeatedly across an extended period (week, months, year) is also needed, as previous studies showed that people who are prone to nostalgia (i.e., high on nostalgia proneness) could experience nostalgia several times a week and the effects of such a regular dose of nostalgia are yet to be investigated. Such methodological refinements would strengthen the generalizability of the results and clarify the role of induction-specific effects in nostalgia research.

Finally, while affective ambivalence was measured, future research might benefit from using qualitative or open-ended data to capture the emotional complexity of nostalgic memories more richly.

### **Ethics Statement**

The study was approved by the Ethics Committee of the St. Petersburg Psychological Society, (approval protocol No. 24 dated 06.07.2023, extension protocol No. 33 dated 11.07.2024).

### **Author Contributions**

L.M. and E.T. conceived of the idea. E.T. developed the theory. A.S. performed the computations. K.B. and E.A. verified the analytical methods. E.S. and M.L. supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

### **Conflict of Interest**

The authors declare that there is no conflict of interest.

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### **References**

- Abu-Rayya, H.M., Abumuhaisen, Y., Wildschut, T., & Sedikides, C. (2025). Nostalgia in the Gaza Strip: Psychological costs and benefits of nostalgia among Palestinian youth. *British Journal of Social Psychology*, 64(2), e12859. <https://doi.org/10.1111/bjso.12859>

- Agha, M. (2019). Nubia Still Exists: On the utility of the nostalgic space. *Humanities*, 8(1), 24. <https://doi.org/10.3390/h8010024>
- Bartseva, K.V., Bi, S., Samarina, Y.S., Likhanov, M.V., & Soldatova, E.L. (2025). Nostal'gicheskie perzhivaniia kitaiskikh studentov v usloviiaxh obrazovatel'noi migratsii [Nostalgic experiences of Chinese students in the context of educational migration] *Vestnik Sankt-Peterburgskogo universiteta. Psikhologiya* [Bulletin of Saint Petersburg University. Psychology], 15(4), 551–577.
- Batcho, K.I. (1995). Nostalgia: A psychological perspective. *Perceptual and Motor Skills*, 80(1), 131–143. <https://doi.org/10.2466/pms.1995.80.1.131>
- Batcho, K.I. (2013). Nostalgia: Retreat or support in difficult times? *The American Journal of Psychology*, 126(3), 355–367. <https://doi.org/10.5406/amerjpsyc.126.3.0355>
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48. <https://doi.org/10.18637/jss.v067.i01>
- Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: Differential susceptibility to environmental influences. *Psychological Bulletin*, 135(6), 885–908. <https://doi.org/10.1037/a0017376>
- Bryant, F.B. (2021). Current progress and future directions for theory and research on savoring. *Frontiers in Psychology*, 12, 771698. <https://doi.org/10.3389/fpsyg.2021.771698>
- Cavanagh, S.R., Glode, R.J., & Opitz, P.C. (2015). Lost or fond? Effects of nostalgia on sad mood recovery vary by attachment insecurity. *Frontiers in Psychology*, 6. <https://doi.org/10.3389/fpsyg.2015.00773>
- Cheung, W.Y., Wildschut, T., Sedikides, C., Hepper, E.G., Arndt, J., & Vingerhoets, A.J.J.M. (2013). Back to the future: Nostalgia increases optimism. *Personality and Social Psychology Bulletin*, 39(11), 1484–1496. <https://doi.org/10.1177/0146167213499187>
- Cox, C.R., Kersten, M., Routledge, C., Brown, E.M., & Van Enkevort, E.A. (2015). When past meets present: The relationship between website-induced nostalgia and well-being. *Journal of Applied Social Psychology*, 45(5), 282–299. <https://doi.org/10.1111/jasp.12295>
- De Villiers, B., Lionetti, F., & Pluess, M. (2018). Vantage sensitivity: A framework for individual differences in response to psychological intervention. *Social Psychiatry and Psychiatric Epidemiology*, 53(6), 545–554. <https://doi.org/10.1007/s00127-017-1471-0>
- Frankenbach, J., Wildschut, T., Juhl, J., & Sedikides, C. (2021). Does neuroticism disrupt the psychological benefits of nostalgia? A meta-analytic test. *European Journal of Personality*, 35(2), 249–266. <https://doi.org/10.1002/per.2276>
- Hepper, E.G., Sedikides, C., Wildschut, T., Cheung, W.Y., Abakoumkin, G., Arikan, G., Aveyard, M., Baldursson, E.B., Bialobrzeska, O., Bouamama, S., Bouzaouech, I., Brambilla, M., Burger, A.M., Chen, S.X., Cisek, S., Demassosso, D., Estevan-Reina, L., González Gutiérrez, R., Gu, L., Zengel, B. (2024). Pancultural nostalgia in action: Prevalence, triggers, and psychological functions of nostalgia across cultures. *Journal of Experimental Psychology: General*, 153(3), 754–778. <https://doi.org/10.1037/xge0001521>
- Holak, S.L., Matveev, A.V., & Havlena, W.J. (2007). Nostalgia in post-socialist Russia: Exploring applications to advertising strategy. *Journal of Business Research*, 60(6), 649–655. <https://doi.org/10.1016/j.jbusres.2006.06.016>
- Kim, D., & Yoon, K.L. (2020). Emotional response to autobiographical memories in depression: Less happiness to positive and more sadness to negative memories. *Cognitive Behaviour Therapy*, 49(6), 475–485. <https://doi.org/10.1080/16506073.2020.1765859>
- Kusumi, T., Matsuda, K., & Sugimori, E. (2010). The effects of aging on nostalgia in consumers' advertisement processing. *Japanese Psychological Research*, 52(3), 150–162. <https://doi.org/10.1111/j.1468-5884.2010.00431.x>
- Layous, K., & Kurtz, J.L. (2023). Nostalgia: A potential pathway to greater well-being. *Current Opinion in Psychology*, 49, 101548. <https://doi.org/10.1016/j.copsyc.2022.101548>
- Layous, K., Kurtz, J.L., Wildschut, T., & Sedikides, C. (2022). The effect of a multi-week nostalgia intervention on well-being: Mechanisms and moderation. *Emotion*, 22(8), 1952–1968. <https://doi.org/10.1037/emo0000817>

- Leunissen, J., Wildschut, T., Sedikides, C., & Routledge, C. (2021). The hedonic character of nostalgia: An integrative data analysis. *Emotion Review*, 13(2), 139–156. <https://doi.org/10.1177/1754073920950455>
- Newman, D.B., & Sachs, M.E. (2020). The negative interactive effects of nostalgia and loneliness on affect in daily life. *Frontiers in Psychology*, 11, 2185. <https://doi.org/10.3389/fpsyg.2020.02185>
- Newman, D.B., Sachs, M.E., Stone, A.A., & Schwarz, N. (2020). Nostalgia and well-being in daily life: An ecological validity perspective. *Journal of Personality and Social Psychology*, 118(2), 325–347. <https://doi.org/10.1037/pspp0000236>
- Osin, E. N. (2012). Izmerenie pozitivnykh i negativnykh emotsii: razrabotka russkoiazыchnogo analoga metodiki PANAS [Measuring Positive and Negative Affect: Development of a Russian-language Analogue of PANAS] *Psikhologiya. Zhurnal Vyshei shkoly ekonomiki* [Psychology. Journal of Higher School of Economics], 9(4), 91–110.
- Peters, R. (1985). Reflections on the origin and aim of nostalgia. *Journal of Analytical Psychology*, 30(2), 135–148. <https://doi.org/10.1111/j.1465-5922.1985.00135.x>
- Reid, C.A., Green, J.D., Buchmaier, S., McSween, D.K., Wildschut, T., & Sedikides, C. (2023). Food-evoked nostalgia. *Cognition and Emotion*, 37(1), 34–48. <https://doi.org/10.1080/02699931.2022.2142525>
- Reid, C.A., Green, J.D., Short, S.D., Willis, K.D., Moloney, J.M., Collison, E.A., Wildschut, T., Sedikides, C., & Gramling, S. (2021). The past as a resource for the bereaved: Nostalgia predicts declines in distress. *Cognition and Emotion*, 35(2), 256–268. <https://doi.org/10.1080/02699931.2020.1825339>
- Reid, C. A., Green, J. D., Wildschut, T., & Sedikides, C. (2015). Scent-evoked nostalgia. *Memory*, 23(2), 157–166. <https://doi.org/10.1080/09658211.2013.876048>
- Santini, F.D.O., Lim, W.M., Ladeira, W.J., Costa Pinto, D., Herter, M.M., & Rasul, T. (2023). A meta-analysis on the psychological and behavioral consequences of nostalgia: The moderating roles of nostalgia activators, culture, and individual characteristics. *Psychology & Marketing*, 40(10), 1899–1912. <https://doi.org/10.1002/mar.21872>
- The World Health Organization — Five Well-Being Index (WHO-5). (n.d.). Retrieved November 15, 2022, from <https://www.corc.uk.net/outcome-experience-measures/the-world-health-organisation-five-well-being-index-who-5/>
- Thompson, M.M., Zanna, M.P., & Griffin, D.W. (1995). Let's not be indifferent about (attitudinal) ambivalence. In R.E. Petty & J.A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 361–386). Lawrence Erlbaum Associates.
- Vartanyan, G.A., Soldatova, E.L., Likhanov, M.V., Bartseva, K.V., & Tsvetkova, E.Y. (2024). Peculiarities of nostalgic experiences of women in a pre-trial detention center. *Psychology and Law*, 14(4), 133–149. <https://doi.org/10.17759/psylaw.2024140409>
- Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037/0022-3514.54.6.1063>
- White, S. (2010). Soviet nostalgia and Russian politics. *Journal of Eurasian Studies*, 1(1), 1–9. <https://doi.org/10.1016/j.euras.2009.11.003>
- Wildschut, T., & Sedikides, C. (2023). Benefits of nostalgia in vulnerable populations. *European Review of Social Psychology*, 34(1), 44–91. <https://doi.org/10.1080/10463283.2022.2036005>
- Wildschut, T., & Sedikides, C. (2024). Psychology and nostalgia: A primer on experimental nostalgia inductions. In T. Becker & D. Trigg (Eds.), *The Routledge handbook of nostalgia* (pp. 54–69). Routledge. <https://doi.org/10.4324/9781003364924-6>
- Wildschut, T., Sedikides, C., & Alowidy, D. (2019). Hanin: Nostalgia among Syrian refugees. *European Journal of Social Psychology*, 49(7), 1368–1384. <https://doi.org/10.1002/ejsp.2590>
- Wildschut, T., Sedikides, C., Arndt, J., & Routledge, C. (2006). Nostalgia: Content, triggers, functions. *Journal of Personality and Social Psychology*, 91(5), 975–993. <https://doi.org/10.1037/0022-3514.91.5.975>

- Yang, N., Ma, H., Huang, M., Lau, E.Y.Y., Fong, D., Wang, M., Wang, P., Xu, S., Xu, J., Jiang, C., Luo, Y., & Meng, R. (2023). Measurement properties and optimal cutoff point of the WHO-5 among Chinese healthcare students. *Psychology Research and Behavior Management*, 16, 5141–5158. <https://doi.org/10.2147/PRBM.S437219>
- Zhou, X., Sedikides, C., Mo, T., Li, W., Hong, E.K., & Wildschut, T. (2022). The restorative power of nostalgia: Thwarting loneliness by raising happiness during the COVID-19 Pandemic. *Social Psychological and Personality Science*, 13(4), 803–815. <https://doi.org/10.1177/19485506211041830>

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## DIFFERENTIAL PSYCHOLOGY

### Parent–Child Relationships and Locus of Control in Two-Child Families

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**Background.** In a rapidly changing society, locus of control becomes an important psychological indicator reflecting an individual's readiness to actively manage their own life. Research shows that an internal locus of control is associated with higher levels of psychological well-being, academic achievement, and social responsibility. The relevance of studying the factors that influence the development of locus of control in childhood and adolescence is determined by its high plasticity during this period and the possibility of targeted influence through the family environment.

**Objective.** The present study focuses on the relationship between parental and child locus of control in the context of parent–child relationships in intact two-child families. Particular attention is given to the analysis of both direct and indirect influences (through parental attitudes) of parental locus of control on children's locus of control.

**Design.** The sample consisted of 278 families (N = 1,112 individuals). The Questionnaire of Locus Control and the "Parent–Child Interaction" questionnaire were used for assessment. Data analysis was conducted using the Actor–Partner Interdependence Model (APIM).

**Results.** Parents with a more internal locus of control demonstrated more positive attitudes toward their children, which in turn was positively associated with the development of an internal locus of control in siblings. Maternal locus of control was found to play a particularly important role, exerting both direct and indirect influences on children's locus of control. Within the parental dyad, maternal influence was expressed not only as actor effects but also as partner effects, through its impact on paternal attitudes toward the children. It was also

**Keywords:**

locus of control, parent-child relationships, siblings, family environment, Actor–Partner Interdependence Model (APIM)

shown that children’s subjective perception of a parental positive attitude is a particularly significant mediator between parental and child locus of control.

**Conclusion.** The obtained data emphasize the significance of the family environment, specifically positive parental attitude, in the formation of locus of control in children.

## **Introduction**

The concept of locus of control was introduced in 1966 and is a central construct of J. B. Rotter’s social learning theory (Nowicki et al., 2021; Rotter, 1966). In general terms, locus of control can be defined as a personality trait that reflects the tendency to attribute one’s successes and failures either to internal or to external factors. Locus of control is a bipolar characteristic. On one pole, the pole of internality, are individuals convinced that what happens to them depends on their personal qualities and that they are able to control their own fate. On the opposite pole, the pole of externality, are individuals who attribute everything that happens to them (successes and failures) to external factors such as fate, chance, or social environment. It is assumed that every person occupies a certain position on the continuum stretching from an external to an internal locus of control. The stability of locus of control as a psychological trait increases with age: longitudinal studies show high variability of this characteristic in childhood and low variability in adulthood (Nowicki et al., 2018).

Locus of control is associated with a wide range of psychological and behavioral characteristics. An internal locus of control is linked to higher levels of tolerance and responsibility (Ahlin & Antunes, 2015), greater self-control, stronger ability to cope with stressful situations, and better adaptation to new conditions (Zulkarnain et al., 2019). It has been shown that adolescents with an internal locus of control are less likely to be involved in violent activities and are more protected from various forms of destructive behavior (Ahlin & Antunes, 2015). Internal locus of control is positively associated with academic achievement (Au, 2015; Strayhorn, 2010) and with higher levels of various cognitive indicators (Anderson et al., 2018), and it is also a significant predictor of both mental and physical health (Botha & Dahmann, 2023; Kesavayuth et al., 2022). In contrast, an external locus of control is positively associated with a greater tendency toward aggressive behavior (Ahlin & Antunes, 2015; Wallace et al., 2012), lower self-esteem, and poorer ability to cope with stressful situations (Asberg & Renk, 2014). Individuals with an external locus of control are also more likely to experience anxiety and are more susceptible to depression (Costantini et al., 2021; Yu & Fan, 2016).

## ***Parent–Child Relationships and Locus of Control***

Studies on the relationship between parental locus of control and children’s locus of control show mixed results. Some studies did not find significant within-pair correlations for this parameter (Becker et al., 2010), while others did report such associations (Chandler et al., 1980). A large longitudinal study involving 3,500 families in England found modest yet significant associations between parental and child locus

of control, measured when the children reached the ages of eight and sixteen (Nowicki et al., 2018).

The influence of parental locus of control on parenting style has often been a subject of research interest (Jain & Lokesh, 2023; Yaffe, 2024). It is assumed that parents' beliefs about their ability to significantly influence life events play an important role in the parenting strategies they use. Studies have shown that an external parental locus of control is associated with a tendency to use violence, particularly physical punishment, toward children (Bugental et al., 1989). A later study on the impact of parenting style on preschoolers' behavioral problems, such as aggression and bullying, found that parents with an external locus of control were less consistent with their children and used punishment more frequently (Kokkinos & Panayiotou, 2007). In contrast, mothers with an internal locus of control, when solving tasks with their child, more often used supportive strategies: they smiled, expressed approval, and showed warmth regardless of the child's success (Carton et al., 1996).

Of particular interest are the data on the relationship between parental (especially maternal) locus of control and children's academic achievement, as well as their behavior at school. Maternal externality is a significant predictor of difficulties in acquiring mathematical knowledge by schoolchildren (Golding et al., 2019). Earlier, the same group of researchers found an effect of maternal locus of control on children's intelligence scores, assessed at the ages of four and eight using the WISC (Golding et al., 2017). Parental locus of control, measured even before the birth of the child, predicted difficulties in school behavior: a prenatal external locus of control in parents was associated with aggression and with systematic failure to follow instructions when learning new material (Nowicki et al., 2018).

It is well known that the quality of family relationships is associated with many personality traits (Chursina, 2025; Huver et al., 2010; Park & Kim, 2024; Quang Dao & Le, 2025). Numerous studies have shown the significant role of the family environment and parental attitudes in the formation of a child's locus of control. Parental warmth, acceptance, and involvement in children's activities are associated with the development of an internal locus of control (Ahlin, 2014; Ahlin & Lobo Antunes, 2015). On the other hand, parental overcontrol and low levels of acceptance are associated with an external locus of control (Spokas & Heimberg, 2009). Overall, a stressful family environment is a substantial predictor of an external locus of control in children. For example, parental alcoholism and mental disorders (Yates et al., 1994), as well as physical punishment and child abuse (Roazzi et al., 2016), are linked to child externality.

Thus, a brief review of the literature shows that locus of control is closely interrelated to the characteristics of the family environment, especially to parameters of parent-child relationships. However, there is a lack of studies that investigate the dyadic influence of parental traits on children's personality. The aim of the present study was to analyze the influence of parental locus of control on children's locus of control, both directly and indirectly — mediated through its effect on parental attitudes toward children. A distinctive feature of this work is the application of the Actor-Partner Interdependence Model (APIM) for data analysis, which was used to assess the interrelationship between participants of the parental dyad on the given in-

dicators. Actor–partner interdependence models were constructed for parental and child locus of control, with various parameters of parental attitudes toward children included as mediating variables.

## **Methods**

### ***Participants***

The study involved 278 intact families with two children, with a total of 1,112 participants. The mean age of fathers was 45 years ( $SD=5.28$ ), mothers — 43 years ( $SD=4.36$ ), older children — 18 years ( $SD=2.31$ ), and younger children — 15 years ( $SD=2.41$ ). At the time of the study, all families were living in Moscow and the Moscow region.

### ***Procedure***

To assess the locus of control of parents and children, the Questionnaire of Subjective Control consisting of 44 items was used (Bazhin et al., 1993).

To evaluate parental attitudes, the “Parent–Child Interaction” questionnaire was applied (Markovskaia, 2006). The questionnaire has two mirror forms, allowing for the collection of both parental and child assessments of the family relationships. A previous factor analysis of this questionnaire, conducted on a sufficiently large sample, showed discrepancies between the factor structures obtained in the parent group and in the child group. Statistical analysis of the parent version revealed five main factors: Parental Positive Attitude, Parental Control, Parental Gentleness, Parental Consistency, and Parent–Child Trust. Statistical analysis of the child version revealed three main factors: Parental Positive Attitude, Parental Control, and Democratic Attitude. All identified factors met validity and reliability criteria (Alekseeva & Kozlova, 2010). In this article, parent–child relationships were assessed using scores based on the factors described above.

### ***Data Processing Methods***

The results were processed using the SPSS Statistics software package, version 18.0. Correlation analysis and paired-sample t-tests were applied. All models were estimated in EQS 6.3 using the ML method.

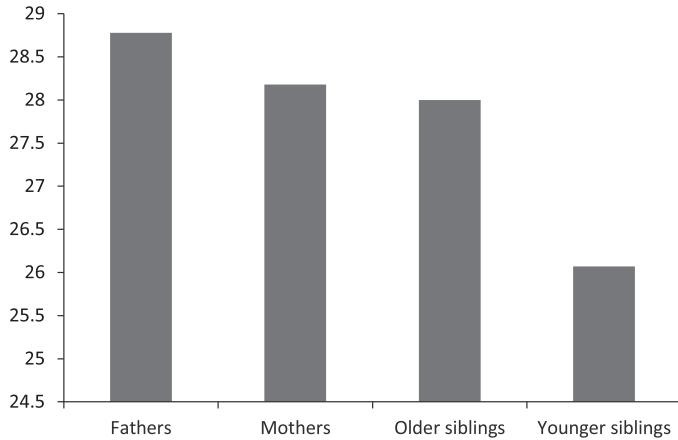
### ***Actor–Partner Interdependence Model***

In the present study, statistical modeling based on the Actor–Partner Interdependence Model (APIM) was applied to assess the relationships between members of the family dyad on the selected variables (Cook & Kenny, 2005; Egorova et al., 2022; Rzhanova, 2024). This type of statistical modeling is capable of revealing how a specific psychological characteristic of one person in a dyad influences certain parameters — both their own (actor effects) and their partner’s (partner effects). Moreover, APIM allows not only the identification of significant associations between variables, but also the examination of the direction of influence from one variable to another, suggesting causal links (Cook & Kenny, 2005; Kim & Kim, 2024). An additional advantage of this method is the ability to include mediating variables in the analysis.

**Results**

***Differences and Similarities in Locus of Control within Family Dyads***

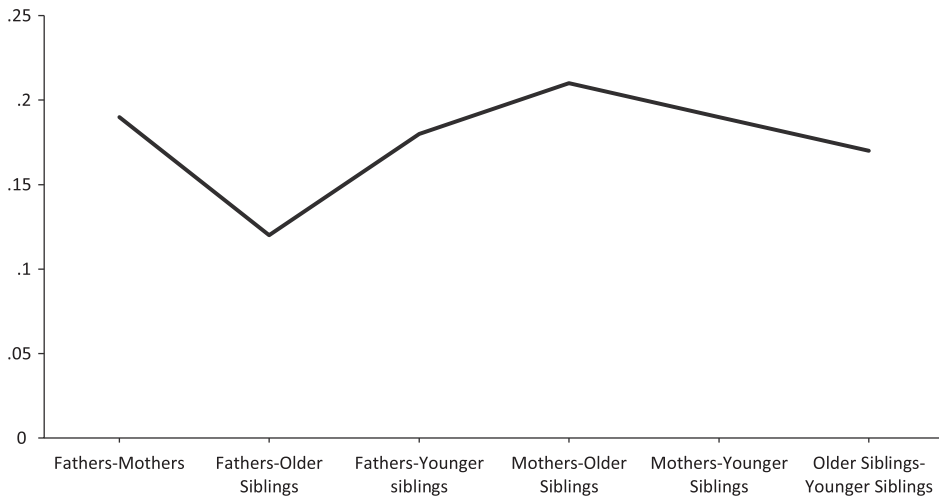
Differences in locus of control scores within family dyads were assessed using Student's t-test. *Figure 1* shows the mean locus of control scores for each family member. Significant differences on this parameter were found for the pairs father–younger sibling ( $t=5.05, p < .01$ ), mother–younger sibling ( $t=3.64, p < .01$ ), and older sibling–younger sibling ( $t=3.59, p < .01$ ). Overall, younger children demonstrated a lower level of locus of control compared to other family members.



*Figure 1.* Mean locus of control scores among family members

***Correlation Between Parental Attitudes Toward Children and Locus of Control***

To analyze the relationships between parental attitudes and locus of control in different family members, we calculated correlations using Spearman's nonparametric coefficient. In particular, within-pair correlations for locus of control in various fam-



*Figure 2.* Within-pair similarity in locus of control

ily dyads were examined (see *Figure 2*). The correlation coefficients were positive and relatively low, reaching statistical significance in all dyads except for father–older child pairs.

In the course of further statistical data processing, correlations were found between locus of control and various parameters of parental attitudes. The strongest correlations with locus of control, both for parents and children, were demonstrated by the parameter Positive attitude toward the child. This association was observed in both the parental and child versions of the questionnaire. The parameter Positive attitude toward the child was obtained through factor analysis of the “Parent–Child Interaction” questionnaire on a fairly large sample of parents and children (Alekseeva & Kozlova, 2010). This parameter has the highest factor loading in both respondent groups and is generally consistent in psychological meaning across the parent and child versions. It reflects the level of parental acceptance and closeness with the child, overall satisfaction with parent–child relationships, as well as parental authority. *Table 1* presents the correlation coefficients between locus of control and Positive attitude toward the child, as assessed by different family members.

**Table 1**

*Association of Locus of Control with the Parameter “Positive Attitude Toward the Child”*

Parental attitude parameters	Father LOC	Mother LOC	Older sibling LOC	Younger sibling LOC
Father’s positive attitude toward older sibling — Parent rating	.21**	.21**	.11	.02
Father’s positive attitude toward younger sibling — Parent rating	.22**	.09	.03	.10
Mother’s positive attitude toward older sibling — Parent rating	.14*	.38**	.07	.12
Mother’s positive attitude toward younger sibling — Parent rating	.13*	.23**	.01	.16*
Father’s positive attitude toward older sibling — Child rating	.13*	.16*	.23**	.08
Father’s positive attitude toward younger sibling — Child rating	.25**	.14*	.10	.21**
Mother’s positive attitude toward older sibling — Child rating	.08	.24**	.18*	.03
Mother’s positive attitude toward younger sibling — Child rating	.10	.14*	.04	.28**

*Note.* \*  $p < .05$ ; \*\*  $p < .01$ .

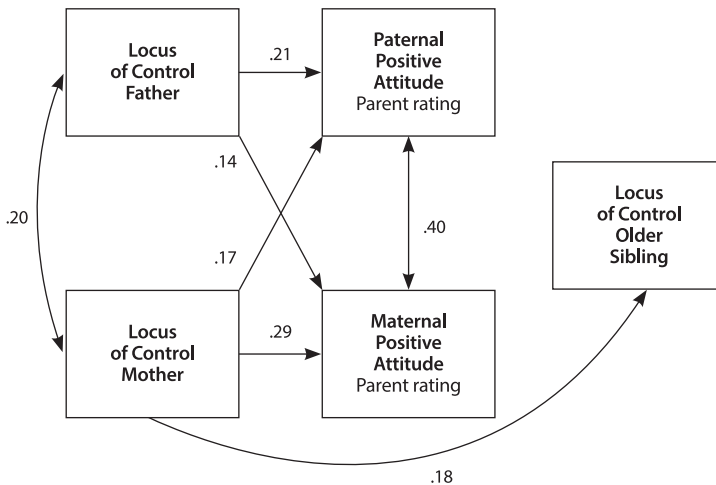
The results indicate that the nature of the associations between locus of control and parental attitudes strongly depends on which family member provides the assessment. Overall, parental locus of control is positively related to both parental and child ratings of positive parental attitudes toward the child. Moreover, maternal locus of control shows more associations compared to paternal locus of control. The higher the level of locus of control in parents, the better their relationships with children are.

The locus of control of both siblings is positively associated with their own ratings of parent–child relationships rather than with parental ratings. Siblings with an internal locus of control tend to evaluate their parents' attitude toward them as more positive.

### ***Analysis of the Relationships Between Locus of Control and Parental Attitudes Using Actor–Partner Modeling***

Based on the results of the correlation analysis, strong relationships were found between parental and child locus of control and the “Positive Parental Attitude Toward the Child” parameter. This led us to hypothesize that this parameter may serve as a mediator through which parental locus of control influences the locus of control of siblings. To test this assumption, APIMs were constructed for both older and younger siblings, in which the parental rating of Positive attitude toward the child served as the mediator between parental and child locus of control (see *Figures 3 and 4*). Both models showed a good fit to the data. The corresponding figures are presented below. All links shown in the figures here and below are statistically significant.

The mother's locus of control has a significant influence on her attitude toward the older child, and a similar, though less pronounced, association is observed for the father's locus of control. Since a positive association was found between both parents' locus of control and their own positive attitude toward the older sibling, we can conclude that significant actor effects of parental locus of control on this parameter of parent–child relationships were obtained. In addition to these actor effects, significant partner effects were also identified: the locus of control of both parents was positively related to the partner's positive attitude toward the child. Thus, a dyad-oriented pattern of mutual influences of parental locus of control on positive attitudes toward the older sibling was revealed. However, the hypothesis of a mediating role of paren-



*Figure 3.* Actor–partner model: dependent variable — locus of control of the older sibling; mediating variable — parental rating of Positive attitude toward the child ( $\chi^2(2) = .722$ ; CFI = 1.000; RMSEA = .000).

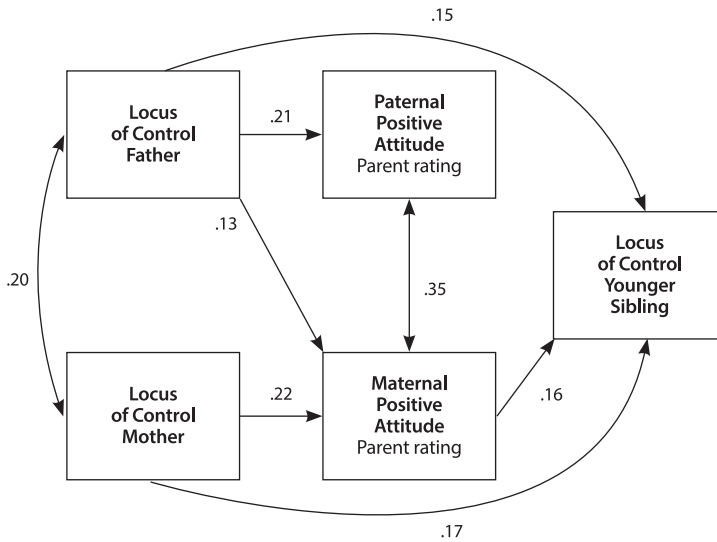


Figure 4. Actor-partner model: dependent variable — locus of control of the younger sibling; mediating variable — parental rating of Positive attitude toward the child ( $\chi^2(3) = 3.704$ ;  $CFI = .992$ ;  $RMSEA = .028$ ).

tal positive attitudes was not confirmed: both maternal and paternal locus of control were directly associated with the same trait in the older sibling.

The actor-partner model examining variables influencing the locus of control of the younger sibling differs from the model constructed for the older sibling (see Figure 4).

Significant positive actor effects of parental locus of control on positive attitudes toward the younger child were obtained. However, a significant partner effect was found only for paternal locus of control: it was associated with the mother's positive attitude toward the younger sibling. Maternal locus of control did not show a partner effect on the father's attitude. Nevertheless, maternal locus of control had a significant influence on the locus of control of the younger child: this association was both direct and indirect, through the mediating variable of maternal positive attitude toward the child. Paternal locus of control also exerted an indirect influence on the locus of control of the younger sibling, expressed as a partner effect, through its impact on maternal attitude.

Further APIMs were constructed in which sibling ratings of parental attitudes served as the mediators between parental and child locus of control (see Figures 5 and 6). Both models showed a good fit to the data.

The locus of control of both parents showed actor effects on how the older sibling evaluated parental attitudes. An internal locus of control in parents is associated with a higher assessment of the parental attitude. The influence of maternal locus of control on the locus of control of the older child was stronger than that of the father, as it was realized indirectly — through both actor and partner effects on parental positive attitude toward the child — as well as directly, through the association between maternal parameters and those of the older child (see Figure 5).

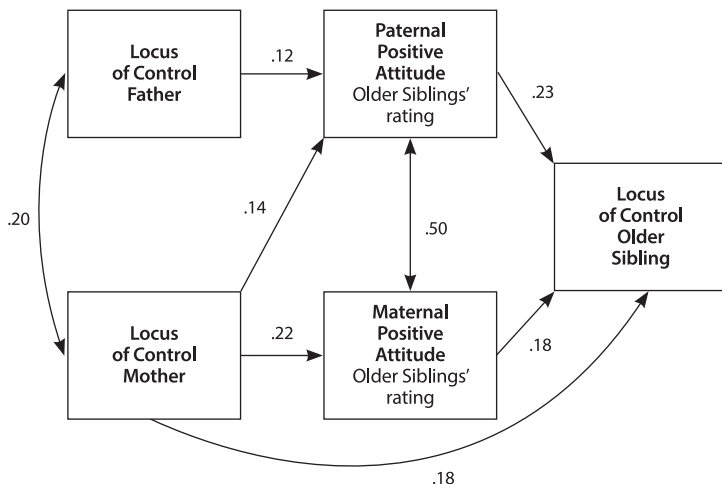


Figure 5. Actor-partner model: dependent variable — locus of control of the older sibling; mediating variable — child rating of positive parental attitude ( $\chi^2(2) = 2.470$ ;  $CFI = .997$ ;  $RMSEA = .025$ ).

The APIM for the younger sibling's ratings is generally similar to the corresponding model for the older sibling. Maternal locus of control exerts both direct and indirect influences on the locus of control of the younger child, with these effects being realized as both actor and partner effects (see Figure 6).

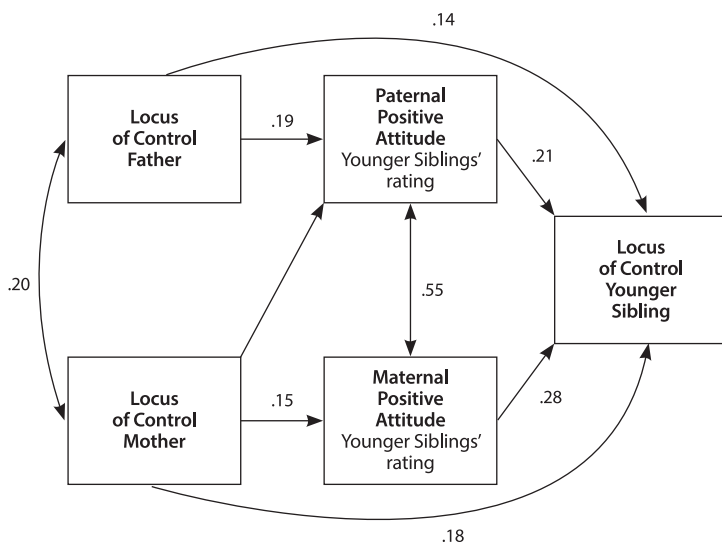


Figure 6. Actor-partner model: dependent variable — locus of control of the younger sibling; mediating variable — child rating of positive parental attitude ( $\chi^2(3) = 1.467$ ;  $CFI = 1.000$ ;  $RMSEA = .000$ ).

## Discussion

The study examined parental attitudes toward children and locus of control across two generations within the same family. The results demonstrate significant differences in locus of control identified across various family dyads. Younger children demonstrated lower levels of locus of control than other family members. This can be explained by age-related influences: the younger siblings who participated in the study were adolescents. It has been established that during childhood and adolescence, locus of control is less stable and more variable compared to older age groups (Nowicki et al., 2018). Within-pair similarities in locus of control across different family dyads were low but statistically significant, with the exception of father–older sibling pairs, where the correlations did not reach the level of statistical significance.

Parental locus of control is positively associated with ratings of positive attitudes toward children. Furthermore, the maternal indicator demonstrates more associations compared to the paternal one. Parents with a more internal locus of control tend to have better relationships with their children, both according to their own assessments and those of their children. Numerous previous studies have revealed a similar pattern (Bugental et al., 1989; Carton & Nowicki, 1996; Kokkinos & Panayiotou, 2007; Nowicki et al., 2018). This association may be because parents with an internal locus of control believe that their behavior and attitudes play a decisive role in the child’s psychological development and that they can actively shape family relationships. As a result, they strive to show greater warmth and acceptance and to monitor and reduce inconsistent or negative reactions toward their children.

The locus of control of siblings is positively correlated with their perceived positive parental attitudes. Children with a more internal locus of control tend to evaluate parental attitudes toward them as more positive compared to children with a more external locus of control. The influence of parental acceptance and warmth on child internality has been demonstrated previously (Ahlin, 2014; Ahlin & Lobo Antunes, 2015). However, a distinctive feature of the present study is that this effect was found primarily when considering children’s own evaluations of parental attitudes.

APIMs were constructed for parental and sibling locus of control, with parental positive attitude toward the child used as the mediating variable. Both parental ratings and children’s ratings were considered. Summarizing the results obtained through actor–partner modeling, it can be concluded that perceived parental positive attitude is an important mediator between parental and child locus of control. Parents with a more internal locus of control influence how children evaluate parental attitudes toward them, and in turn, parental attitude is a significant predictor in the development of siblings’ locus of control.

This result supports the widely recognized scientific assumption that subjective perception of events (including those within the family) is the most important environmental factor in the formation of personality traits (Gidziela et al., 2023; Turkheimer & Waldron, 2000). The recognition of the importance of environmental influences as lived and perceived “objective” experience has a long history of study, both in Russian and international psychological traditions (Grishina, 2012).

Maternal locus of control, more often than paternal locus of control, exerts both direct effects on sibling personality characteristics and indirect effects through mediating variables, namely parameters of parental attitudes. The influence of maternal locus of control on siblings within the parental dyad is realized not only as actor effects but also as partner effects, that is, through its impact on paternal attitudes toward the children.

## **Conclusion**

In today's rapidly changing world, locus of control is an extremely important personality characteristic that reflects a person's confidence in their ability to meaningfully influence their own life despite the fast-paced changes around them. Individuals with an internal locus of control show higher levels of mental and physical health, are less vulnerable to stress and depression, and are less prone to deviant behavior.

In the present study, the relationship between parental attitudes and locus of control across two generations of families was examined using actor-partner interdependence modeling. The findings highlight the important role of parental positive attitude as a mediator between parental and child locus of control. Parents with an internal locus of control relate to their children in a more consistent and warm manner, which, in turn, positively influences the development of internality in siblings. The results emphasize the particular significance of perceived parental attitudes in linking parental and child personality characteristics. Maternal locus of control, more often than paternal locus of control, was associated with the corresponding characteristic in children both directly and indirectly — through parameters of parental attitudes — operating as both actor and partner effects.

## **Limitations**

This study has several limitations. First, its cross-sectional design precludes causal interpretations of the observed associations between parental and child locus of control. Second, the sample was limited to intact families with two children, limiting the generalizability of the findings to other family structures. In addition, the study did not account for socio-economic variables that might influence both parenting practices and children's locus of control.

## **Ethics Statement**

Informed consent was obtained from participants and parents of participating children before the study. The data collection procedure complied with the ethical standards of the Russian Psychological Society.

## **Informed Consent from the Participants' Legal Guardians (if the participants were minors)**

Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## Author Contributions

Irina E. Rzhanova conceived of the idea, developed the theory, and performed the computations. Olga S. Alekseeva verified the analytical methods and supervised the findings of this work.

The two authors discussed the results and contributed to the final manuscript.

## Conflict of Interest

The authors declare no conflict of interest.

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## References

- Ahlin, E.M. (2014). Locus of control redux: Adolescents' choice to refrain from violence. *Journal of Interpersonal Violence, 29*(14), 2695–2717. <https://doi.org/10.1177/0886260513520505>
- Ahlin, E.M., & Lobo Antunes, M.J. (2015). Locus of control orientation: Parents, peers, and place. *Journal of Youth and Adolescence, 44*(9), 1803–1818. <https://doi.org/10.1007/s10964-015-0253-9>
- Alekseeva, O., & Kozlova, I. (2010). Faktorizatsiia oprosnika roditel'sko-detskikh otnoshenii na vyborke dvukhdentnykh semei [Factorization of the parent–child relationship questionnaire in a sample of two-child families]. *Psikhologicheskie Issledovaniia* [Psychological Studies], 3(11). <https://doi.org/10.54359/ps.v3i11.914>
- Anderson, E., Cochrane, A., Golding, J., & Nowicki, S. (2018). Locus of control as a modifiable risk factor for cognitive function in midlife. *Aging, 10*(7), 1542–1555. <https://doi.org/10.18632/aging.101490>
- Asberg, K., & Renk, K. (2014). Perceived stress, external locus of control, and social support as predictors of psychological adjustment among female inmates with or without a history of sexual abuse. *International Journal of Offender Therapy and Comparative Criminology, 58*(1), 59–84. <https://doi.org/10.1177/0306624X1246147>
- Au, E.W. (2015). Locus of control, self-efficacy, and the mediating effect of outcome control: Predicting course-level and global outcomes in an academic context. *Anxiety, Stress, and Coping, 28*(4), 425–444. <https://doi.org/10.1080/10615806.2014.976761>
- Bazhin, E.F., Golyunkina, E.A., & Etkind, A.M. (1993). Oprosnik urovnia subektivnogo kontroliia (USK) [Questionnaire on the level of subjective control (LSC)]. Smysl.
- Becker, K.D., Ginsburg, G.S., Domingues, J., & Tein, J.-Y. (2010). Maternal control behavior and locus of control: Examining mechanisms in the relation between maternal anxiety disorders and anxiety symptomatology in children. *Journal of Abnormal Child Psychology, 38*, 533–543. <https://doi.org/10.1007/s10802-010-9388-z>
- Botha, F., & Dahmann, S. (2023). Locus of control, self-control, and health outcomes. *SSM-Population Health, 24*(25), 101566. <https://doi.org/10.1016/j.ssmph.2023.101566>
- Bugental, D.B., Blue, J., & Cruzcosa, M. (1989). Perceived control over caregiving outcomes: Implications for child abuse. *Developmental Psychology, 25*(4), 532–539. <https://doi.org/10.1037/0012-1649.25.4.532>
- Carton, J.S., Nowicki, S.Jr., & Balsler, G.M. (1996). An observational study of antecedents of locus of control of reinforcement. *International Journal of Behavioral Development, 19*(1), 161–175. <https://doi.org/10.1177/016502549601900112>

- Chandler, T., Wolf, F., Cook, B. & Dugovics D. (1980). Parental correlates of locus of control in fifth graders: an attempt at experimentation in the home. *Merrill-Palmer Quarterly*, 26, 183–195.
- Chursina, A.V. (2025). Image of the family and orienting image of attachment: A psychosemantic approach. *Psychology in Russia: State of the Art*, 18(4), 205–218. <https://doi.org/10.11621/pir.2025.0411>
- Costantini, I., Kwong, A., Smith, D., Lewcock, M., Lawlor, D.A., Moran, P., Tilling, K., Golding, J. & Pearson, R.M. (2021). Locus of control and negative cognitive styles in adolescence as risk factors for depression onset in young adulthood: Findings from a prospective birth cohort study. *Frontiers in Psychology*, 12:599240. <https://doi.org/10.3389/fpsyg.2021.599240>
- Cook, W.L., & Kenny, D.A. (2005). The actor–partner interdependence model: A model of bidirectional effects in developmental studies. *International Journal of Behavioral Development*, 29(2), 101–109. <https://doi.org/10.1080/01650250444000405>
- Egorova, M.S., Parshikova, O.V., Chertkova, Iu.D., & Mitina, O.V. (2022). Temnaia triada i bazovye tsennosti: samootsenki i vzaimnye otsenki v parakh mat'-doch' [The Dark Triad and basic values: Self- and mutual assessments in mother–daughter pairs]. *Novye Psikhologicheskie Issledovaniia* [New Psychological Research], 1, 108–136. [https://doi.org/10.51217/npsyresearch\\_2022\\_02\\_01\\_06](https://doi.org/10.51217/npsyresearch_2022_02_01_06)
- Gidziela, A., Malanchini, M., Rimfeld, K., McMillan, A., Ronald, A., Viding, E., Pike, A., Asbury, K., Eley, T.C., von Stumm, S., & Plomin, R. (2023). Explaining the influence of non-shared environment (NSE) on symptoms of behaviour problems from preschool to adulthood: Mind the missing NSE gap. *Journal of Child Psychology and Psychiatry*, 747–757. <https://doi.org/10.1111/jcpp.13729>.
- Golding, J., Gregory, S., Ellis, G.L., Iles-Caven, Y., & Nowicki, S. (2017). Prenatal internal locus of control is positively associated with offspring IQ, mediated through parenting behavior, prenatal lifestyle and social circumstances. *Frontiers in Psychology*, 8, 1429. <https://doi.org/10.3389/fpsyg.2017.01429>
- Golding, J., Gregory, S., Ellis, G., Nunes, T., Bryant, P., Iles-Caven, Y., & Nowicki, S. (2019). Maternal prenatal external locus of control and reduced mathematical and science abilities in their offspring: A longitudinal birth cohort study. *Frontiers in Psychology*, 10, 194. <https://doi.org/10.3389/fpsyg.2019.00194>
- Grishina, N.V. (2012). Situatsionnyi podkhod i ego empiricheskie prilozheniia [The situational approach and its empirical applications]. *Psikhologicheskie Issledovaniia* [Psychological Studies], 5(24), 2.
- Huver, R.M., Otten, R., de Vries, H. & Engels, R. (2010) Personality and parenting style in parents of adolescents. *Journal of Adolescence*, 33(3), 395–402. <https://doi.org/10.1016/j.adolescence.2009.07.012>
- Jain, A. & Lokesh, L. (2023). Perceived parenting styles on locus of control and coping strategies among young adults. *International Journal of Indian Psychology*, 11(3), 1526–1537. <https://doi.org/10.25215/1103.146>
- Kesavayuth, D., Binh Tran, D., & Zikos, V. (2022). Locus of control and subjective well-being: Panel evidence from Australia. *PLoS One*, 17(8), e0272714. <https://doi.org/10.1371/journal.pone.0272714>
- Kim, H., & Kim, J.S. (2024). Extending the actor-partner interdependence model to accommodate multivariate dyadic data using latent variables. *Psychological Methods*, 890–918. <https://doi.org/10.1037/met0000531>
- Kokkinos, C.M., & Panayiotou, G. (2007). Parental discipline practices and locus of control: Relationship to bullying and victimization experiences of elementary school students. *Social Psychology of Education: An International Journal*, 10(3), 281–301. <https://doi.org/10.1007/s11218-007-9021-3>
- Markovskaia, I.M. (2006). Trening vzaimodeistviia roditel'ei s det'mi [Training of parent–child interaction]. *Rech'*
- Nowicki, S., Gregory, S., Ellis, G., Iles-Caven, Y., & Golding, J. (2018). The pattern of stability and change in parental locus of control over 6 years and teacher ratings of child behavior. *Frontiers in Psychology*, 9, 1427. <https://doi.org/10.3389/fpsyg.2018.01427>
- Nowicki, S., Iles-Caven, Y., Kalechstein, A., & Golding, J. (2021). Editorial: Locus of control: Antecedents, consequences and interventions using Rotter's definition. *Frontiers in Psychology*, 12:698917. <https://doi.org/10.3389/fpsyg.2021.698917>
- Park H., Kim S. (2024). Effects of perceived parent–child relationships and self-concept on creative personality among middle school students. *Behavioral Sciences*, 14(1), 58. <https://doi.org/10.3390/bs14010058>

- Quang Dao, P., Le, D.H. (2025). Differentiating the effects of fathers' and mothers' parenting styles on academic and emotional outcomes among male and female Vietnamese students, *Psychology in Russia: State of the Art*, 18(4), 36–69. <https://doi.org/10.11621/pir.2025.0403>
- Roazzi, A., Attili, G., Di Pentima, L., & Toni, A. (2016). Locus of control in maltreated children: The impact of attachment and cumulative trauma. *Psicologia: Reflexão e Crítica*, 29, 8. <https://doi.org/10.1186/s41155-016-0025-9>
- Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied*, 80(1), 1–28. <https://doi.org/10.1037/h0092976>
- Rzhanova, I.E. (2024). Nevrotizm i roditel'skii kontrol' v dvukhidentnykh sem'iaxh [Neuroticism and parental control in two-child families]. *Novye Psikhologicheskie Issledovaniia* [New Psychological Research], 4, 91–112. [https://doi.org/10.51217/npsyresearch\\_2024\\_04\\_04\\_04](https://doi.org/10.51217/npsyresearch_2024_04_04_04)
- Spokas, M., & Heimberg, R.G. (2009). Overprotective parenting, social anxiety, and external locus of control: Cross-sectional and longitudinal relationships. *Cognitive Therapy and Research*, 33(6), 543–551. <https://doi.org/10.1007/s10608-008-9227-5>
- Strayhorn, T.L. (2010). When race and gender collide: Social and cultural capital's influence on the academic achievement of African American and Latino males. *Review of Higher Education*, 33(3), 307–332. <https://doi.org/10.1353/rhe.0.0147>
- Turkheimer, E., Waldron, M. (2000). Nonshared environment: A theoretical, methodological, and quantitative review. *Psychological Bulletin*, 126(1), 78–108. <https://doi.org/10.1037/0033-2909.126.1.78>
- Wallace, M.T., Barry, C.T., Zeigler-Hill, V., & Green, B.A. (2012). Locus of control as a contributing factor in the relation between self-perception and adolescent aggression. *Aggressive Behavior*, 38(3), 213–221. <https://doi.org/10.1002/ab.21419>
- Yates, B.T., Hecht-Lewis, R., Fritsch, R.C., & Goodrich, W. (1994). Locus of control in severely disturbed adolescents: Loci for peers, parents, achievement, relationships, and problems. *Journal of Youth and Adolescence*, 23, 289–314. <https://doi.org/10.1007/BF01536721>
- Yaffe, Y. (2024). Parental overprotection and locus of control as the mechanisms explaining the relationship between parent and child anxiety: A multiple mediation model. *Child Psychiatry and Human Development*. <https://doi.org/10.1007/s10578-024-01757-4>
- Yu, X., Fan, G. (2016). Direct and indirect relationship between locus of control and depression. *Journal of Health Psychology*, 21(7), 1293–1298. <https://doi.org/10.1177/1359105314551624>
- Zulkarnain, Z., Daulay, D.A., Yusuf, E.A., & Yasmin, M. (2019). World assumptions and youth identity as predictors of social activity preferences. *Psychology in Russia: State of the Art*, 12(2), 115–133. <https://doi.org/10.11621/pir.2019.0209>

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## Altered System-Level Integration Between Working Memory and Gaze Dynamics in Children Treated for Posterior Fossa Tumors

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**Background.** In recent years, experimental studies concerning the role of the cerebellum in cognitive functions and a variety of language deficits have been conducted.

**Objective.** To evaluate the impact of posterior fossa tumors (PFT) on spatial working memory and eye-movement behavior during reading in children and to compare the system-level organization of working memory and gaze-related parameters between patients and typically developing peers.

**Design.** This retrospective cohort study applied advanced analytical methods, including Drift Diffusion Modeling (DDM) and Recurrence Quantification Analysis (RQA), to capture the temporal dynamics of cognitive processing and oculomotor control. The study included 119 children aged 8 to 17 years: 59 survivors of posterior fossa tumors and 60 healthy controls. Working memory was assessed using the Spatial Span task from the CANTAB battery, modeled using DDM parameters, while eye movements during reading were recorded with eye tracking and analyzed using RQA. Network analysis was conducted to characterize cross-domain integration between working memory dynamics and gaze behavior.

**Results.** Our findings indicate that cerebellar disruption due to tumor and treatment affects not only isolated aspects of reading or eye-movement behavior, but also the functional coordination between working memory and oculomotor control. Stronger working memory capacity was associated with more organized and predictable gaze dynamics in controls, whereas patients showed reduced flexibility and altered connectivity patterns. RQA parameters captured a unified dynamical system, linking cognitive control and motor implementation during reading.

**Keywords:** cerebellum, posterior fossa tumor, eye movements, working memory, visual-spatial ability, reading

**Conclusion.** These findings highlight the importance of considering subtle, system-level disruptions in posterior fossa tumor patients and underscore the relevance of using multimodal, temporally sensitive approaches when designing rehabilitation protocols.

## Introduction

Cognitive functioning is a complex system of mental processes that enable the perception, storage, processing, and utilization of environmental information. Two critical components of this system are visual perception and working memory, whose interaction is essential for goal-directed behaviors, including reading (Kofler et al., 2019). Visual perception initiates sensory selection and preliminary analysis of visual stimuli, while working memory maintains and manipulates this information to guide ongoing tasks and behavioral responses (Baddeley, 2007). Such interaction between visual perception and working memory is fundamental for reading, an intricate cognitive activity that demands synchronized functioning of visual, mnemonic, and executive systems (Peng et al., 2018; Sarver et al., 2012). The cerebellum, traditionally recognized for its role in motor coordination, has increasingly been shown to contribute significantly to cognitive functions such as attention, working memory, decision-making, and oculomotor control (Bellebaum & Daum, 2007; Koziol et al., 2012). Robust evidence points to specific cerebello-cortical connections activated during cognitive tasks, emphasizing the cerebellum's integral role in higher-order processing beyond purely motoric functions (Pelzer et al., 2017). Cerebellar lesions, common among children surviving posterior fossa tumors (PFT), often lead to persistent cognitive and motor deficits, despite high survival rates (Cámara et al., 2020; Zilli et al., 2021). These deficits result primarily from surgical intervention, radiotherapy, and chemotherapy, which disrupt cortico-cerebellar pathways (Tanedo et al., 2022). Although cognitive and motor impairments in pediatric patients have been extensively studied, disturbances in reading—an essential skill crucial for academic success—have received comparatively little attention.

Reading difficulties following cerebellar lesions likely arise due to compromised control of eye movements, with specific cerebellar regions playing critical roles in oculomotor functioning (Beh et al., 2017). Key reading-related oculomotor characteristics, such as fixation duration, the number of fixations, and frequency of regressive saccades, may be disrupted in individuals with cerebellar pathology (Litovchenko, 2012; Rimrodt et al., 2009; Tomaiuolo et al., 2021). Additionally, the interplay between visual-spatial working memory and oculomotor control during reading underscores the integration of motor and cognitive functions. Hence, cerebellar lesions may induce impairments not merely at isolated perceptual or motor levels, but also at integrative, system-level interactions between cognition and eye movement control, potentially affecting broader cognitive outcomes, including academic achievement.

Given that reading and working memory depend on coordinated interactions across multiple cognitive and oculomotor subsystems, alterations following cerebel-

lar injury may be better understood by analyzing system-level organization rather than isolated behavioral outcomes.

Standard neuropsychological assessments often overlook subtle yet impactful network-level disruptions in cognitive architecture. Therefore, understanding how cognitive processes interact—not just their isolated performance—is essential. To address this gap, the current study employs a system-level approach, integrating advanced analytical methods such as Drift Diffusion Modeling (DDM), Recurrence Quantification Analysis (RQA) of eye movements, and network modeling (Anderson et al., 2013; LaCombe & Barenholtz, 2015; Tschense & Wallot, 2020). Drift Diffusion Modeling is a computational framework used to decompose decision-making processes into underlying cognitive components such as evidence accumulation rate, response thresholds, and non-decision time, thereby providing insight into subtle cognitive changes not evident from behavioral data alone (Ratcliff & McKoon, 2008; Turner et al., 2016; Velichkovsky et al., 2020; Voronin et al., 2020; Zakharov & Ismatullina, 2021; Zhuikov, 2021). The model provides a rigorous mathematical framework that decomposes observed decision-making behavior into underlying cognitive processes. Initially developed to model simple two-choice decisions, DDM has since become a cornerstone methodology in cognitive psychology. It offers researchers insight into the latent mechanisms operating between stimulus presentation and response execution. In recognition memory paradigms, the model differentiates memory strength, represented by the drift rate, from response bias, captured by the starting point parameter. This clear dissociation has significantly enhanced our understanding of how factors such as aging, brain injury, and individual variability influence memory-based decision-making (Myers et al., 2022). In clinical practice, the DDM is used to study changes in cognitive processes associated with various disorders. For example, research has shown alterations in DDM parameters in patients with Parkinson's disease, attention deficit hyperactivity disorder (ADHD), autism spectrum disorders, obsessive-compulsive disorder (OCD), and schizophrenia. The model helps to understand whether these patients' behavioral difficulties are related to slowed information processing (drift rate), changes in decision strategy ("caution," threshold width), or problems with motor output (non-decision time) (Gupta et al., 2022).

Recurrence Quantification Analysis (RQA) is a nonlinear analytical technique employed to quantify temporal patterns and complexity within gaze trajectories, capturing the dynamics and predictability of eye movements during reading (Anderson et al., 2013; Emel'ianova & Runnova, 2021; Kirichenko et al., 2016; Kiselev, 2006; Zhuravlev et al., 2023; Tschense & Wallot, 2020; Zhuykov, 2021).

Network modeling is widely used in medical psychology for analyzing complex interactions between symptoms, cognitive functions, and neurophysiological indicators (Andronova & Kapuza, 2025; Artemenkov, 2021; Shmukler et al., 2020; National Research University Higher School of Economics, n.d.). Network modeling complements these approaches by characterizing how cognitive and oculomotor variables are organized into interconnected systems, rather than isolated components. It enables the identification of integration strength, modular structure, and central nodes within the cognitive-motor network, providing a structural perspective on how

cerebellar pathology may alter coordination across domains (Borsboom et al., 2021; Epskamp et al., 2018).

Employing these methods enables a fine-grained analysis of cognitive–motor integration and provides critical insights into the subtle disruptions associated with cerebellar pathology.

The primary goal of the present research is thus to elucidate how posterior fossa tumors and their treatment affect the dynamic interplay between working memory and eye-movement control during reading among pediatric patients. Specifically, we aim to:

1. Evaluate differences in visual-spatial working memory performance and decision-making parameters (DDM) between posterior fossa tumors (PFT) patients and healthy controls;
2. Compare eye-movement behaviors during reading tasks, particularly focusing on recurrence-based metrics of gaze stability and complexity (RQA), between the two groups;
3. Perform an exploratory network analysis to model the structure of cognitive–oculomotor relationships and reveal reorganizations associated with cerebellar injury.

We hypothesize that cerebellar disruption due to posterior fossa tumors results in measurable alterations of cognitive architecture, characterized by reduced integration between memory and motor systems, and changes in the dynamical complexity of eye-movement patterns. By modeling these interdependencies directly, the present study seeks to uncover sensitive markers of systemic cognitive disruption, informing both clinical assessment and targeted rehabilitation strategies.

## Methods

### *Participants*

The study included a total of 119 children aged between 8 and 17 years. Of this group, 59 children ( $M = 12.49$  (2.5) y.o.; 44 % male) were treated for a posterior fossa tumor according to the HIT MED 2017 protocol, and went into remission successfully (patient group, PG). The other 60 children ( $M = 13.03$  (2.67) y.o.; 47 % male) formed the control group (CG). The participants were native Russian speakers and had attended school for at least two years.

The PG included participants with tumors located in the brain and/or cerebellar hemisphere and fourth ventricle. All children had completed treatment, including surgery, chemotherapy, and were in remission. The duration of remission ranged from a minimum of 3 months to a maximum of 158 months ( $M = 47.37$ ,  $SD = 37.22$ ). The age at disease onset ranged from 3 months to 16 years ( $M = 6.98$ ,  $SD = 3.4$  years).

### *Procedure*

The assessment was conducted as a single-session procedure by licensed neuropsychologists. Patient evaluations were carried out by a clinical psychologist at the

Russkoye Pole Clinical Rehabilitation Research Center of the Dmitry Rogachev National Medical Research Center of Pediatric Hematology, Oncology, and Immunology. All participants older than 15 years and the legal representatives of younger children gave written informed consent before the initial tests. All testing for the control group took place in a quiet room in the children's school during school hours by trained research assistants. The CANTAB and reading tasks were administered in one session lasting approximately 30 minutes, with a 5-minute break between tasks to reduce fatigue.

### *Spatial Span (SSP)*

We selected the Spatial Span (SSP) test to evaluate Spatial Working Memory. A computerized version of the Corsi blocks from Cambridge Neuropsychological Test Automated Battery (CANTAB) was used. In this task, the participant needs to memorize and reproduce the sequence of elements, the number of which increases from 2 to 9. The average testing time was about 5 minutes. Answers were recorded using a touch screen. Descriptions of the test parameters (Cambridge Cognition, n.d.; Downes et al., 2006) are presented in *Table 1*.

**Table 1**

*Assessment Score from SSP Test and DDM Parameters*

Parameter	Meaning
Span length	This is the longest sequence successfully recalled by the subject. The subject has three attempts at each level.
Total errors	The number of times the subject selected an incorrect box.
Number of attempts (span length $n$ )	The number of attempts that the subject made for the span length, which can be set to a number from 2 to 9.
Mean time to last response (span length $n$ )	The mean time the subject took to complete problems of the span length $n$ (i.e., make $n$ responses), which can be set for a number from 2 to 9. The time is measured from the end of the presentation phase (the moment the final box closes) to the time of the subject's final response on a given attempt. Attempts undertaken on spans that the subject did not pass are included in this calculation.
Drift rate ( $v$ )	The speed and efficiency of evidence accumulation.
Decision boundary ( $a$ )	The threshold of accumulated evidence needed to make a response.
Non-decision time ( $t_0$ )	The capturing processes unrelated to the decision itself, such as stimulus encoding and motor execution.

To characterize the temporal dynamics of behavior in the SSP task, we employed a drift diffusion model (DDM), a class of sequential sampling models traditionally used to describe decision-making in two-alternative forced-choice paradigms (Bogacz et al., 2006). In its classical formulation, the DDM models the accumulation of noisy evidence over time until a decision boundary is reached (Myers et al., 2022; Voronin et al., 2020; Voss et al., 2015).

In the present study, however, the SSP task does not consist of isolated binary decisions, but rather of extended action sequences that depend on an internal representation maintained in working memory. Accordingly, we adopted an extended, episode-level interpretation of the DDM, in which each behavioral sequence was treated as a single decision episode. Under this formulation, the model captures the integrated dynamics of behavior across the entire sequence, rather than modeling individual step-wise choices.

Within this framework, the DDM parameters were interpreted as follows. The drift rate reflects the efficiency of information accumulation over the course of the sequence, incorporating all sources of information available to the participant, including those related to the internal representation of the sequence. The decision boundary represents the response criterion or degree of caution, corresponding to the level of accumulated information required for committing to or completing the behavioral episode. The non-decision time accounts for processes not directly related to evidence accumulation, such as perceptual encoding and motor execution.

Importantly, this application should be understood as a phenomenological parameterization of behavior at the level of the full sequence, rather than a mechanistic model of individual step-level decisions. We do not assume that the DDM captures the internal microstructure of sequential choices within the SSP task.

This approach is consistent with broader perspectives on sequential sampling models as general frameworks for evidence accumulation (Forstmann et al., 2016; Gold & Shadlen, 2007), with interpretations of decision boundaries as reflecting optimal stopping or control criteria (Drugowitsch et al., 2012), and with prior work demonstrating that evidence accumulation can extend across temporally structured sequences rather than being confined to isolated trials (Nguyen et al., 2019).

DDM parameters were estimated for each participant using the PyDDM Python package (Shinn & Lam, 2018), based on individual reaction time data and binary response outcomes (*Table 1*).

### *Reading Task*

We used seven grammatically simple texts (36–65 words) taken from a Russian-language textbook recommended by the Ministry of Education of the Russian Federation for elementary schools. Children read the excerpts presented on the screen, and two questions were asked after each text to ensure they understood the meaning. Participants read at their own pace to avoid mistakes.

Oculomotor function was recorded every 1/60 s monocularly by an Arrington eye-tracking system (Arrington Research Inc., Scottsdale, Arizona, USA) with chin support. The stimulus was displayed on the monitor (Samsung, 23", resolution 1920×1080 pixels) with a distance of 60 cm. The center of vision is determined by locating the center of the pupil. Calibration was conducted using the standard nine-point algorithm.

Eye-tracking data were preprocessed using a custom Python pipeline. Raw gaze recordings were segmented into text-related intervals and smoothed with a Savitzky–Golay filter. Eye-tracking data were analyzed using Recurrence Quantification Analysis (RQA), a nonlinear dynamical approach providing detailed characterization of gaze trajectory complexity. RQA metrics were computed using the pyunicorn library

(Donges et al., 2016). Specific RQA parameters included recurrence rate (RR, proportion of gaze positions revisited), laminarity (LAM, gaze stability in specific screen regions), and entropy of diagonal lines (ENT, complexity of gaze pattern sequences). RQA parameters were calculated separately for each reading segment (each text) and then aggregated as mean and standard deviation values across segments to capture both general gaze behavior and variability across reading tasks.

### **Statistical Analysis**

To examine associations among eye-movement metrics, recurrence quantification analysis (RQA) measures, spatial span performance, and diffusion decision model (DDM) parameters, we conducted Spearman rank-order correlation analyses, suitable for non-parametric data and potential outliers. P-values were adjusted for multiple comparisons using the Holm correction. To assess differences between pediatric patients and healthy controls, we used analysis of covariance (ANCOVA), controlling for age and gender. Effect sizes for group comparisons were estimated using eta-squared ( $\eta^2$ ) to quantify the proportion of variance explained by each factor.

We used Gaussian Graphical Models (GGM) with graphical lasso regularization (Friedman et al., 2008) to build sparse partial correlation networks between working memory, oculomotor (RQA), and decision-making (DDM) metrics. Joint networks were estimated via EBICglasso in the bootnet R package (Epskamp et al., 2018) for different participant groups, with variables z-standardized and age regressed out using ordinary least squares regression. Absence of edges indicates associations fully explained by other variables.

Networks were represented as weighted undirected graphs (edge weights = regularized partial correlations). Data were nonparanormal-transformed using huge.npn (huge package) prior to estimation. Communities were detected via Clique Percolation Method with optimal k/I from maximum signed fuzzy modularity. The Minimum Spanning Tree (MST) extracted the core structural skeleton.

Centrality stability was assessed via case-wise bootstrapping Correlation Stability (CS) coefficients ( $r \geq .70$  threshold; higher = more stable). Node strength was calculated as the sum of absolute incoming partial correlations.

Follow-up networks incorporated clinical predictors (age of onset, treatment duration, remission, surgical history), with age regressed out, to examine interactions with cognitive/oculomotor systems.

## **Results**

### **ANCOVA Results for Spatial Span, Drift Diffusion Model, and RQA Parameters**

Descriptive statistics for each of the parameters were calculated separately for SSP, DDM, and RQA measures in the two groups shown in *Table 2*.

An analysis of covariance (ANCOVA) was conducted to test for mean differences between patients and control groups. Three-way ANCOVAs with 2 (gender) by 2 (Group) by age design were fitted. The results of the analysis are presented in the combined table (*Table 3*). Age was included as a covariate.

**Table 2***Descriptive Statistics for SSP, DDM and RQA Measures in the Two Groups*

Variable	Mean (SD)	Mean (SD)	
		Patient group	Control group
Span length	6.032(1.55)	5.86 (1.48)	6.22 (1.62)
Attempts	1.03 (.18)	1.03 (.17)	1.033 (.18)
Total errors	14.18 (6.66)	14.88 (6.2)	13.42 (7.1)
Mean time last response	3,938.095 (1,020.89)	4,068.455 (1,174.41)	3,794.7 (805.42)
Drift	.1 (.07)	.08 (.06)	.12 (.07)
Bound	2.91 (.36)	2.96 (.33)	2.86 (.39)
Nondectime	.93 (.10)	.94 (.08)	.92 (.12)
Mean of recurrence rate	.04 (.04)	.03 (.03)	.05 (.04)
Standard deviation of recurrence rate	.02 (.02)	.02 (.02)	.03 (.02)
Mean of laminarity	.87 (.08)	.87 (.06)	.86 (.09)
Standard deviation of laminarity	.06 (.05)	.05 (.03)	.07 (.05)
Mean of entropy of diagonal lines	2.34 (.43)	2.27 (.37)	2.41 (.47)
Standard deviation of entropy of diagonal lines	.36 (.19)	.32 (.16)	.41 (.2)

Note: *Nondectime* = non-decision time.

To account for potential confounding effects of gender and age, an ANCOVA was performed to compare span length between children in the PFT group and the control group.

For Spatial Span (SSP) performance, significant small-to-moderate effects were observed for gender ( $p = .042$ ,  $\eta^2 = .034$ ) and age ( $p = .003$ ,  $\eta^2 = .071$ ) on span length, suggesting that these demographic factors substantially contribute to individual differences in working memory span. Conversely, neither group membership ( $p = .277$ ,  $\eta^2 = .010$ ) nor group  $\times$  gender interaction ( $p = .692$ ,  $\eta^2 = .001$ ) significantly influenced span length. Regarding the number of attempts, a small yet significant group  $\times$  gender interaction emerged ( $p = .043$ ,  $\eta^2 = .033$ ), indicating subtle, sex-dependent variations in how children engaged with the SSP task.

Other SSP measures, including total errors, and reaction times, revealed no significant group or demographic differences, except for mean time to last response, which showed a minor but significant effect of age ( $p = .040$ ,  $\eta^2 = .034$ ).

Analysis of parameters obtained from DDM indicated a robust main effect of the group on drift rate ( $p = .001$ ,  $\eta^2 = .083$ ), reflecting a moderate effect size; specifically, PFT patients showed significantly slower evidence accumulation compared to controls. Additionally, age significantly contributed to drift rate ( $p = .005$ ,  $\eta^2 = .063$ ), further emphasizing developmental impacts on cognitive processing speed. Neither gender ( $p = .163$ ) nor group interactions significantly affected DDM decision boundary or non-decision time.

**Table 3**

ANCOVA Results

		Group		Gender		Age		Group* Gender	
		F	$\eta^2p$	F	$\eta^2p$	F	$\eta^2p$	F	$\eta^2p$
SSP	Span length	1.19	.01	4.24*	.03	9.25**	.07	.16	.00
	Attempts	.05	.00	.02	.00	.30	.00	4.18*	.03
	Total errors	1.81	.02	.01	.00	2.37	.02	.01	.00
	Mean time last response	1.84	.02	.33	.00	4.32*	.03	.07	.00
DDM	Drift	10.89**	.08	1.97	.02	8.09**	.06	.09	.00
	Bound	2.13	.02	1.15	.01	.45	.00	.64	.01
	Nondectime	1.76	.01	1.64	.01	.07	.00	.42	.00
RQA	Mean of recurrence rate	10.03*	.08	4.75*	.04	22.26**	.16	.94	.01
	Standard deviation of recurrence rate	9.03*	.07	2.43	.02	17.35**	.13	.05	.00
	Mean of laminarity	.40	.00	.55	.01	1.55	.01	.18	.00
	Standard deviation of laminarity	4.88*	.04	.76	.01	7.77*	.06	.73	.01
	Mean of entropy of diagonal lines	3.22	.03	.20	.00	2.06	.02	.02	.00
	Standard deviation of entropy of diagonal lines	5.91**	.05	.08	.00	1.13**	.08	.02	.00

Note. Level of significance: \*  $p < .05$ , \*\*  $p < .01$

Analysis of parameters obtained from RQA yielded prominent differences in mean recurrence rate (RR mean), with significant effects observed for group ( $p = .002$ ,  $\eta^2 = .077$ ), gender ( $p = .031$ ,  $\eta^2 = .038$ ), and notably age ( $p < .001$ ,  $\eta^2 = .155$ ), underscoring a strong developmental component. Similar moderate effects emerged for RR variability (RR SD), with significant influences of group ( $p = .003$ ,  $\eta^2 = .070$ ) and age ( $p < .001$ ,  $\eta^2 = .126$ ).

No significant group or demographic effects were observed for mean values of laminarity, and entropy (all  $p > .20$ ;  $\eta^2 < .02$ ). However, their temporal variability (*SD* values) showed meaningful differences: laminarity *SD* varied significantly by group ( $p = .029$ ,  $\eta^2 = .039$ ) and age ( $p = .006$ ,  $\eta^2 = .061$ ); entropy *SD* showed significant effects of group ( $p = .017$ ,  $\eta^2 = .047$ ) and age ( $p = .002$ ,  $\eta^2 = .078$ ); Overall, these findings suggest that temporal variability in gaze behavior is particularly sensitive to both clinical factors and developmental stage, even when mean values remain stable.

## Network Analysis Results

Before constructing the network models, we conducted a series of preliminary correlation analyses to evaluate whether a network approach was warranted and to determine which variables should be included. Specifically, we examined pairwise associations among all cognitive and oculomotor measures using Spearman correlations, computed separately for the control and clinical groups. In this step, we also assessed correlations with age to identify variables substantially shaped by developmental effects. Because age showed widespread associations across domains, we treated it as a confounding factor and removed its influence prior to network estimation. The results are provided in the *Appendix, Tables 1-2*.

We additionally explored associations between the cognitive–oculomotor indicators and clinical variables, including age at disease onset and remission duration, to determine which clinical factors should enter the network model. Only remission duration ( $\rho = -.33, p < .01$ ) demonstrated consistent and interpretable associations with core gaze-related metrics (entropy (*SD*)), and was therefore included as the sole clinical variable in the patient network.

Then we constructed separate networks for the control and patient groups, initially including age as a factor due to its significant influence on all measures. Following the guidelines by Epskamp et al. (2018), the Correlation Stability (CS) coefficient indicates how much of the sample can be dropped while retaining a correlation of at least .70 between original and bootstrapped centrality estimates. CS values above .50 are considered good, values above .25 are acceptable, and values below .25 indicate that centrality indices are unreliable. In our analysis, the clinical network reached a  $CS = .45$ , falling within the acceptable range and indicating reasonably robust centrality estimates. By contrast, the control network showed  $CS = .28$ , just above the minimum acceptable threshold, suggesting that although interpretable, its centrality structure is more sensitive to sampling variation. This pattern indicates greater structural consistency in the clinical group and higher variability in the normative network.

The constructed network for control and patient groups without age effects is presented in *Figure 1*.

The network analysis of the control group reveals a highly structured and modular organization, characterized by two distinct, functionally specialized clusters. The first green cluster included cognitive measures from the Spatial Span (SSP) task - span length (SpLen), along with core Drift Diffusion Model (DDM) parameters such as decision boundary (Bound) and standard deviation of recurrence rate (RR SD) from oculomotor parameters. Notably, some SSP test indicators and the DDM model indicators turned out to be related, but were not included in the cluster. Furthermore, behavioral measures such as the number of attempts and the mean time for last responses in the SSP test were separate and showed no significant connections to other variables. The strong positive connection between Bound (decision threshold) and Span Length (performance) highlights a successful speed-accuracy tradeoff, where a more cautious strategy leads to better outcomes. Basically, the Bound is how our brain shows a plan in thinking, and this is linked to the brain's stability, measured by recurrence rate (RR SD). Together, they help achieve better high-level thinking,

Figure 1A

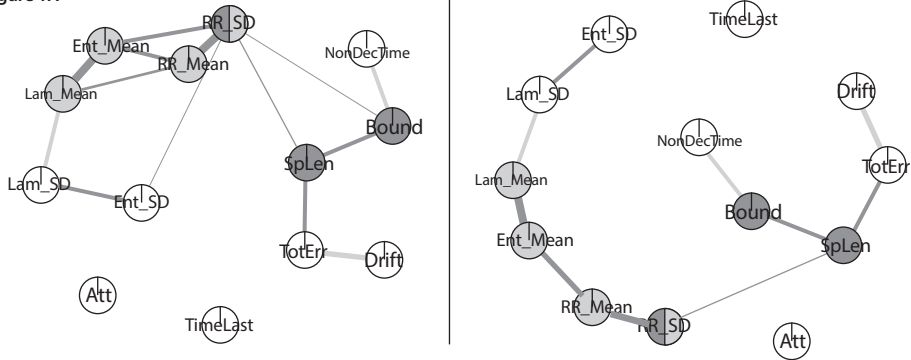


Figure 1B

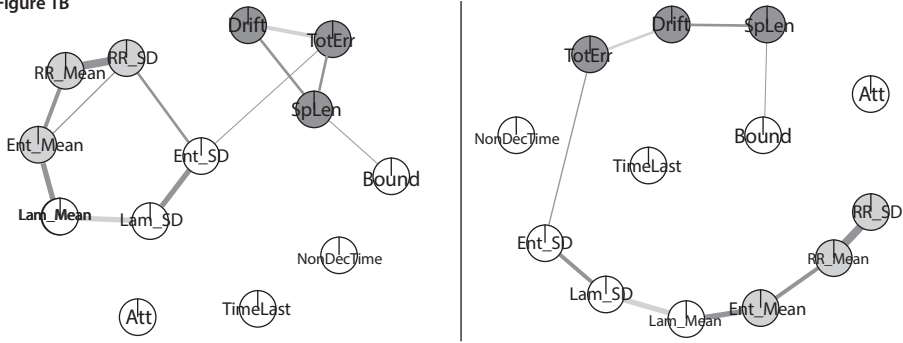


Figure 1C

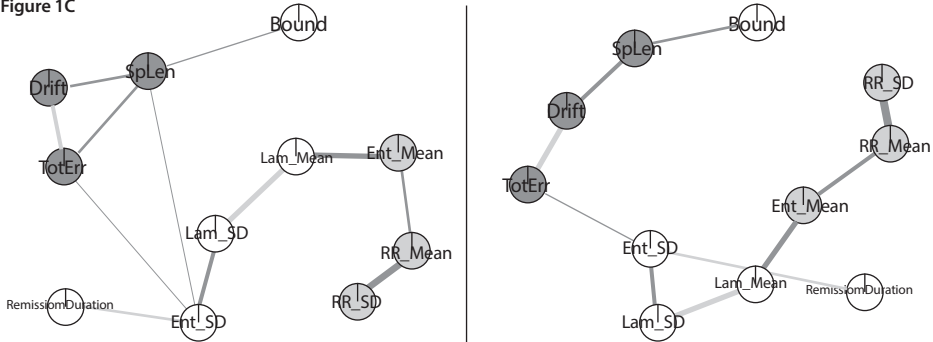


Figure 1. A. Network (left) and corresponding MST (right) for the control group with age effect removed. B. Network (left) and corresponding MST (right) for the group of patients with age affect removed. C. Network (left) and corresponding MST (right) for the group of patients with age affect removed with clinical factors.

Notes. Different colors represent the membership of variables to specific clusters; thicker lines between variables indicate a stronger connection; color of lines indicates direction of correlation between variables — green positive and red negative. Abbreviations: Drift — drift rate; Boundary — decision boundary; Non-DecTime — non-decision time; SpLen — span length of SSP test; Att — number of attempts in SSP test; TotErr — total errors of SSP test; TimeLast — mean time of last response in SSP test; RR Mean — mean of recurrence rate; RR SD — standard deviation of recurrence rate; Lam Mean — mean of laminarity; Lam SD — standard deviation of laminarity; Ent Mean — mean of entropy; Ent SD — standard deviation of entropy; RemissionDuration — duration of remission

like longer span in memory tasks. Also, the clear link among these three elements in cluster shows an important idea that successful working memory performance is not just a cognitive act, it is a psychophysiological state supported by a specific neural dynamic.

The second cluster (red) contains eye movement parameters (RQA) such as mean and standard deviation of recurrence rate with mean of entropy (Ent Mean) and mean of laminarity (Lam Mean). This combination points to a unified functional module in the brain's oculomotor system that governs the stability, complexity, and predictability of visual processing. This cluster shows that this brain system is not fixed. It naturally varies between stability and change. This flexibility is significant for adapting, like smoothly shifting focus from one object to quickly exploring the surroundings. Basically, it represents the main brain activity needed for effective visual gathering of information. By analyzing the network structure, the most influential nodes were identified. Results are provided in the *Appendix, Tables 3–5*. The analysis included key metrics such as the mean entropy (.875), the mean recurrence rate (.789), and the standard deviation of the recurrence rate (.782). These measures help evaluate the complexity, stability, and variability of the system, allowing us to determine which nodes play crucial roles within the network. The MST confirms this modular organization segregation of cognitive and eye-movement variables, where the standard deviation of recurrence rate acts as a link between task performance and eye movement. As in the main network, indicators of behavioral measures such as the number of attempts and the mean time for last responses in the SSP test were separate and showed no significant connections to other variables.

We also constructed a network for a group of patients without age effects. Figure 1B shows that the network also has two clusters as in the control group, but it is formed with different parameters.

Analyzing the clinical group, we found a network structure that differs from the control group. The first cluster (green), similar to the control group, included cognitive and DDM parameters, but did not contain indicators from RQA. Besides Span Length, which was also present in the control group, this cluster also included Total Errors and Drift. This suggests that cognitive and oculomotor processes are more disconnected and operate independently. We observed only a weak connection with the standard deviation of the entropy which reflects the system's dynamic complexity. Similar to the control group, the number of attempts and the mean response time at the end of the SSP test were isolated and showed no significant links to other variables, including non-decision time.

The second cluster (red) included eye movement parameters from RQA, such as the mean and standard deviation of the recurrence rate, along with the mean entropy (Ent Mean). However, it did not include the mean of laminarity (Lam Mean), which was present in the control group. While Lam Mean still relates to other oculomotor measures, it no longer forms part of a united neurodynamic pattern. Instead, it may operate independently, potentially manifesting as maladaptive "stuckness" or, conversely, an inability to stay focused. In this group, the most influential nodes were the standard deviation of the recurrence rate (.918), the mean recurrence rate (.893), and the mean entropy (.875). Notably, the Recurrence Rate *SD* became the most central

node in the entire network, signaling a shift toward increased instability in neurodynamic states. This shift implies that the system is dominated by fluctuations and inconsistencies rather than stable average properties. The higher overall strength of variability metrics, such as Recurrence Rate *SD* and mean entropy, suggests that the system is primarily driven by instability, which may also lead to increased rigidity. The MST analysis of the clinical group shows a less resilient, more linear network structure. The weak link between cognitive and oculomotor parameters is confirmed by the standard deviation of entropy, which indicates how well the brain's control systems manage transitions between cognitive states.

Group comparisons using the Network Comparison Test (NCT) did not yield statistically significant differences in either global strength or overall network structure. Although this result suggests broad similarity between the two networks, it should be interpreted with caution. Prior work indicates that the NCT is sensitive to sample size and may have limited statistical power in cases of small groups or subtle differences, increasing the likelihood of false-negative outcomes (van Borkulo et al., 2023; Borsboom et al., 2021). Given these methodological considerations, the absence of significant findings should not be taken as strong evidence for network equivalence. Instead, the present comparisons are best viewed as exploratory, offering preliminary indications rather than definitive conclusions about potential similarities or differences between groups.

An additional network analysis incorporating the clinical variable of remission duration was performed for the patient group, again controlling for age. Before estimating this model, isolated nodes with no stable connections (e.g., error-related indicators) were removed to ensure a coherent network structure. The resulting clinical-remission network showed moderate stability ( $CS = .35$ ), which was lower than the stability observed in the age-only clinical model.

The constructed network for a group of patients without age effects with clinical factors is presented in *Figure 1C*.

The resulting network structure was similar to the previous patient-only network, maintaining two clusters. The clinical factor — duration of remission — was negatively associated with standard deviation of entropy. Longer clinical remission was associated with lower variability (more stability) in the entropy over time. Conversely, shorter or less stable remission was linked to less stability in entropy. In this network, the most influential nodes were the standard deviation of the recurrence rate (.973), the mean recurrence rate (.944), and the mean entropy (.919). Similar results were obtained in the clinical group without assessing the inclusion of remission time indicators. Also, like networks in patients without indicators of remission time, the MST emphasized entropy *SD* as a pivotal connector, linking cognitive and oculomotor clusters and mediating relationships between clinical and gaze dynamics during reading tasks. The negative connection between standard deviation of entropy and duration of remission in MST shows that the consistent, time-related stability of neural complexity — more than just its average level — is a key factor for long-term recovery. This suggests that steady neural dynamics are an important protective factor against relapse, making it a valuable focus for monitoring and treatment.

## Discussion

We examined visuospatial working memory (SSP/DDM), reading gaze dynamics (RQA), and cross-domain organization in pediatric PFT survivors vs. typically developing peers. Goals: to compare memory/decision dynamics, characterize recurrence-based gaze, and explore network associations. Patients showed preserved SSP accuracy (span length, errors; driven by age/gender effects), altered DDM dynamics, and rigid oculomotor patterns. Entropy variability — indexing gaze adaptability across segments (Sokolov et al., 2017) — was reduced, decreasing further with remission duration.

SSP robustness suggests compensatory fronto-parietal support post-treatment (Savage et al., 2007). However, accuracy metrics underestimate alterations by ignoring temporal dynamics, missing latent disruptions masked by compensation (Gao et al., 2024). Temporally resolved models are needed to reveal regulatory changes.

In contrast, dynamic markers from DDM revealed clear group distinctions. Patients showed reduced drift rate, indicating less efficient evidence accumulation, while decision boundary and non-decision time remained comparable across groups. The negative association between drift rate and SSP errors demonstrates that dynamic parameters capture meaningful individual differences even in the absence of accuracy-based group differences. This dissociation between preserved performance and altered temporal dynamics underscores the selective vulnerability of cerebellar-supported timing mechanisms: cerebellar disruption may affect how cognitive operations unfold over time without necessarily degrading overt task outcomes.

RQA revealed clear developmental effects and group differences in the temporal organization of gaze during reading. Recurrence rate, laminarity, and entropy were strongly interrelated across participants, reflecting the structured and temporally stable nature of gaze control. Age was a major predictor of recurrence-related metrics, consistent with the maturation of oculomotor stability throughout childhood and adolescence.

Importantly, group differences emerged not in mean-level values but in variability-based measures. Patients showed reduced variability in laminarity and entropy along with higher recurrence rate and recurrence variability. This pattern reflects more constrained, stereotyped, and less adaptable gaze dynamics. The divergence between mean-level measures (which remained similar) and variability (which strongly differentiated the groups) aligns with theoretical accounts emphasizing that neurodynamic flexibility, not average behavior, carries clinically relevant information after neurological insult (Marusak et al., 2018). Variability captures the system's capacity to adjust to moment-to-moment demands; reduced variability points to a shift toward rigidity and diminished adaptive modulation. This divergence reinforces the notion that variability-based indices often reveal dysfunction more clearly than mean-level metrics, because they capture the system's adaptive capacity rather than its average state.

In the context of cerebellar dysfunction, reduced variability and increased recurrence likely represent attempts to stabilize sensory input by narrowing the range of possible oculomotor states. Such compensation may support adequate performance during reading but at the cost of reduced adaptability when processing demands fluctuate.

tuates. This mechanistic interpretation complements the preserved SSP accuracy despite altered drift-rate dynamics: patients may sustain behavior through stereotyped visuomotor strategies that reduce cognitive load.

Network analysis provided an integrated view of how cognitive and oculomotor processes relate within each group. In typically developing children, SSP and DDM variables formed a cohesive cognitive cluster, reflecting complementary facets of the same underlying working-memory operation. Oculomotor variables formed coherent sub-networks capturing temporal stability (laminarity) and dynamical complexity (entropy, recurrence rate). Centrality estimates identified laminarity and span length as influential nodes, consistent with evidence linking structured gaze behavior to efficient information processing (Ferguson et al., 2021; Rayner et al., 2006).

In patients, networks showed reduced integration: SSP/DDM remained connected (despite altered dynamics), but had weaker, diffuse oculomotor links. Laminarity decoupled from its cluster, entropy had sparse connections, and oculomotor coherence decreased—paralleling group-level variability reductions and cross-domain decoupling. Entropy variability was highly central, bridging cognitive, oculomotor, and clinical nodes.

Decision boundary became isolated, indicating disrupted deliberation-working memory coordination (consistent with preserved accuracy but altered dynamics). Despite separate tasks, joint organization indexes shared mechanisms such as attentional control and cerebellar temporal integration.

Patient networks showed higher stability (CS coefficient), reflecting rigid architecture with less individual variability and narrower configurations (vs. adaptive control networks).

Remission duration predicted lower entropy variability, indicating consolidation of rigid gaze strategies (not flexibility recovery). Entropy variability marks cerebello-cortical reorganization (Gao et al., 2024; Kasatkin et al., 2022; Rimrodt et al., 2009); early interventions are needed to restore adaptability.

Together, the findings indicate that pediatric cerebellar injury alters the adaptability and coordination of distributed cognitive–motor systems, rather than producing categorical behavioral deficits. The cerebellum plays a central role in temporal integration across frontal and parietal networks (Strick et al., 2009) involved in attention, working memory, and executive control (Clark et al., 2021; Iosif et al., 2023). Reduced drift rate, decreased variability in gaze metrics, and weaker cognitive–oculomotor coupling are consistent with disruptions to timing-based modulation that normally enables fluid coordination between cognitive processes and gaze control (Kim et al., 2021).

Importantly, these alterations likely reflect broader cerebello–cortical disruption rather than focal cerebellar damage alone (Schmahmann et al., 2007). Posterior fossa tumors and their treatments can affect cerebellar outflow pathways, fronto-parietal control networks, and long-range timing circuits, producing downstream consequences for attentional allocation, working-memory regulation, and oculomotor adaptability (Guell et al., 2018; Stoodley & Schmahmann, 2010). Reduced variability and increased network rigidity may thus reflect compensatory strategies that stabilize performance by narrowing the range of possible cognitive and gaze-control

states. Classical accuracy metrics, which index end-point performance rather than temporal dynamics, may fail to detect such adaptations, highlighting the value of dynamic and integrative approaches such as DDM, RQA, and exploratory network methods.

Developmentally, reduced oculomotor flexibility and fragmented cross-domain organization may reflect deviations in the calibration of cognitive–motor systems rather than isolated impairments. The cerebellum contributes to the maturation of distributed neural networks, and early injury may alter the developmental trajectories through which cognitive and oculomotor functions become coordinated. This perspective emphasizes the need to conceptualize pediatric cerebellar injury as a systemic reorganization of cognitive architecture, with potential long-term implications for adaptability and learning (Dalboni da Rocha et al., 2024).

Longitudinal and interventional research will be valuable for determining whether gaze-control flexibility and cross-domain network organization can be enhanced through targeted training, such as visual–motor coordination tasks or dynamic attentional interventions. It will also be important to assess whether entropy variability or network connectivity can serve as prognostic or treatment-responsive indicators. Combining behavioral, neural, and computational tools may help clarify mechanisms underlying reduced dynamical complexity and support the development of individualized rehabilitation strategies.

## Conclusion

Pediatric PFT survivors showed altered cognitive-oculomotor organization vs. controls, despite preserved working memory accuracy. Integrating DDM, RQA, and networks revealed disrupted evidence accumulation, reduced gaze flexibility, and fragmented topology: controls had coherent clusters with entropy as the key hub; patients showed weaker cognitive-oculomotor links and central entropy variability indexing neurodynamic integrity.

Taken together, these findings illustrate the value of moving beyond isolated behavioral outcomes toward temporally resolved and network-oriented approaches capable of detecting subtle disruptions in cognitive organization that may not be apparent in standard performance measures. The prominence of entropy variability as a cross-domain connector suggests promising avenues for future assessment and monitoring efforts, particularly in identifying children who may benefit from interventions aimed at enhancing cognitive flexibility and oculomotor adaptability.

## Limitations

This study has several limitations that warrant consideration. First, the network-based findings should be interpreted as exploratory. Network estimation and comparison procedures are sensitive to modeling choices—including variable selection, regularization, and bootstrapping assumptions—and the resulting structures require replication to establish their robustness. Complementary analytic approaches (*e.g.*, Bayesian networks or dynamical-systems modeling) and independent samples will be important for confirming the stability of these patterns.

Second, the cross-sectional design limits our ability to determine causal relationships or characterize developmental trajectories following cerebellar injury. Longitudinal approaches will be essential for understanding how cognitive–oculomotor coupling evolves over time and how these changes relate to factors such as treatment history and remission duration.

Third, although the clinical group reflects the heterogeneity typical of pediatric posterior fossa tumor survivors—including differences in tumor type, treatment modalities, and disease progression—this diversity may introduce confounding variance. Such heterogeneity increases ecological validity, but may limit the specificity with which particular mechanisms or pathways can be linked to the observed network alterations.

Fourth, although we employed detailed behavioral and computational measures, the absence of neuroimaging data limits the interpretation of the neural substrates underlying the observed cognitive–oculomotor reconfiguration. Structural or functional imaging could help clarify whether altered interactions reflect disruptions within cerebellar–cortical pathways or more widespread changes in distributed networks.

A further limitation stems from the lack of eye-tracking data during the working memory task. While reading-based eye-movement measures provide rich dynamical information, the inability to monitor gaze behavior during the SSP task constrains our understanding of how oculomotor patterns contribute to, or compensate for, working-memory demands. Integrating eye-tracking into memory tasks in future work would help disentangle sources of behavioral variability—such as fluctuations in attention, encoding efficiency, or strategy use—and determine whether similar organizational patterns emerge outside the reading context.

Finally, we did not collect information on participants' engagement in cognitive rehabilitation, educational supports, medication use, or socioeconomic factors. These contextual variables may shape both developmental outcomes and the compensatory strategies children employ to manage cognitive demands. Their inclusion in future research would provide a more comprehensive understanding of individual differences in recovery and adaptation.

### **Ethics Statement**

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the Dmitry Rogachev National Medical Research Center of Pediatric Hematology, Oncology, and Immunology (protocol number 8e/13-17 of 27.10.2017).

### **Informed Consent from the Participants' Legal Guardians**

Informed consent was obtained from all subjects involved in the study.

### **Author Contributions**

Conceptualization, S.Mi., V.I., T.A., S.Ma.; methodology, S.Mi., V.I., T.A., S.Ma.; software, S.Mi., T.A.; validation, T.A., S.Mi.; formal analysis, V.I., T.A., S.Mi.; investiga-

tion, S.Mi.; resources, S.Mi.; data curation, S.Mi.; writing—original draft preparation, S.Mi., V.I., S.Ma.; writing—review and editing, T.A., S.Ma.; visualization, S.Mi.; supervision, S.Ma.; project administration, V.I., S.Ma. All authors have read and agreed to the published version of the manuscript.

## Conflict of Interest

The authors declare that there is no conflict of interest.

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## References

- Anderson, N.C., Bischof, W.F., Laidlaw, K.E.W., Risko, E.F., & Kingstone, A. (2013). Recurrence quantification analysis of eye movements. *Behavior Research Methods*, *45*(3), 842–856. <https://doi.org/10.3758/s13428-012-0299-5>
- Andronova, E.Yu., & Kapuza, A.V. (2025). Metriki tsentral'nosti setevogo analiza kak instrument opredeleniia urovnia abstraktsii poniatii vnutri poniatiinnoi struktury obuchaiushchikhhsia. [Centrality metrics in network analysis as a tool for determining the level of abstraction of concepts within students' conceptual structures]. *Psikhologicheskie Issledovaniia* [Psychological Research], *102*(18), 3. <https://doi.org/10.54359/48gtcd95>
- Artemenkov, S.L. (2021). Problemy postroeniia i analiza uporiadochennykh setei chastnykh korreliatsii v psikhologicheskikh issledovaniakh [Problems of constructing and analyzing ordered networks of partial correlations in psychological research]. *Modelirovanie i analiz dannykh* [Modeling and Data Analysis], *11*(3), 36–56. <https://doi.org/10.17759/mda.2021110303>
- Baddeley, A. (2007). *Working memory, thought, and action*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780198528012.001.0001>
- Beh, S.C., Frohman, T.C., & Frohman, E.M. (2017). Cerebellar control of eye movements. *Journal of Neuro-Ophthalmology*, *37*(1), 87–98. <https://doi.org/10.1097/WNO.0000000000000456>
- Bellebaum, C., & Daum, I. (2007). Cerebellar involvement in executive control. *Cerebellum*, *6*(3), 184–192. <https://doi.org/10.1080/14734220601169707>
- Bogacz, R., Brown, E., Moehlis, J., Holmes, P., & Cohen, J.D. (2006). The physics of optimal decision making: A formal analysis of models of performance in two-alternative forced-choice tasks. *Psychological Review*, *113*(4), 700–765. <https://doi.org/10.1037/0033-295X.113.4.700>
- Borsboom, D., Deserno, M.K., Rhemtulla, M., Epskamp, S., Fried, E.I., McNally, R.J., Robinaugh, D.J., Perugini, M., Dalege, J., Costantini, G., Isvoranu, A.-M., Wysocki, A.C., van Borkulo, C.D., van Bork, R., & Waldorp, L.J. (2021). Network analysis of multivariate data in psychological science. *Nature Reviews Methods Primers* *1*, 58 <https://doi.org/10.1038/s43586-021-00055-w>
- Cámara, S., Fournier, M.C., Cordero, P., Melero, J., Robles, F., Estesó, B., Vara, M.T., Rodríguez, S., Las-saletta, Á., & Budke, M. (2020). Neuropsychological profile in children with posterior fossa tumors with or without postoperative cerebellar mutism syndrome (CMS). *Cerebellum*, *19*(1), 78–88. <https://doi.org/10.1007/s12311-019-01088-4>
- Cambridge Cognition (n.d.). *Digital cognitive assessments*. Retrieved November 23, 2025 from <https://cambridgecognition.com/digital-cognitive-assessments/>
- Clark, S.V., Semmel, E.S., Aleksonis, H.A., Steinberg, S.N., & King, T.Z. (2021). Cerebellar-subcortical systems as modulators of cognitive functions. *Neuropsychology Review*, *31*(3), 422–446. <https://doi.org/10.1007/s11065-020-09465-1>

- Dalboni da Rocha, J.L., Zou Stinnett, P., Scoggins, M.A., McAfee, S.S., Conklin, H.M., Gajjar, A., & Sitarum, R. (2024). Functional MRI assessment of brain activity patterns associated with reading in medulloblastoma survivors. *Brain Sciences*, 14(9), 904. [mhttps://doi.org/10.3390/brainsci14090904](https://doi.org/10.3390/brainsci14090904)
- Donges, J.F., Schleussner, C.F., Siegmund, J.F., & Donner, R.V. (2016). Event coincidence analysis for quantifying statistical interrelationships between event time series: On the role of flood events as possible triggers of epidemic outbreaks. *European Physical Journal Special Topics*, 225(3), 471–487. <https://doi.org/10.1140/epjst/e2015-50233-y>
- Downes, J., Evenden, J., Morris, R., Owen, A., Robbins, T., Roberts, A., & Sahakian, B. (2006). *CANTAB™ test administration guide*. Cambridge Cognition.
- Drugowitsch, J., Moreno-Bote, R., Churchland, A.K., Shadlen, M.N., & Pouget, A. (2012). The cost of accumulating evidence in perceptual decision making. *Journal of Neuroscience*, 32(11), 3612–3628. <https://doi.org/10.1523/JNEUROSCI.4010-11.2012>
- Emel'ianova, E.P., Runnova, A.E. (2021). Avtomaticheskii analiz vyrazhennosti individual'nykh osobennosti v mnogokanal'nykh signalakh EEG na baze rekurrentnogo analiza [Automatic analysis of the expressiveness of individual features in multichannel EEG signals based on recurrence analysis]. In Antonets, V.A., Parin, S.B., Iakhno, V.G. (Eds), *Nelineinaia dinamika v kognitivnykh issledovaniakh – 2021. Trudy VII Vserossiiskoi konferentsii* [Nonlinear Dynamics in Cognitive Research – 2021: proceedings of the VII All-Russian Conference] (pp. 41–42). Institut prikladnoi fiziki Rossiiskoi akademii nauk (Nizhniy Novgorod)
- Epskamp, S., Borsboom, D., & Fried, E.I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. *Behavior Research Methods*, 50(1), 195–212. <https://doi.org/10.3758/s13428-017-0862-1>
- Ferguson, H.J., Brunson, V.E., & Bradford, E.E. (2021). The developmental trajectories of cognitive function from adolescence to old age. *Scientific Reports*, 11, 1382. <https://doi.org/10.1038/s41598-020-80866-1>
- Forstmann, B.U., Ratcliff, R., & Wagenmakers, E.-J. (2016). Sequential sampling models in cognitive neuroscience: Advantages, applications, and extensions. *Annual Review of Psychology*, 67, 641–666. <https://doi.org/10.1146/annurev-psych-122414-033645>
- Friedman, J., Hastie, T., & Tibshirani, R. (2008). Sparse inverse covariance estimation with the graphical lasso. *Biostatistics*, 9(3), 432–444. <https://doi.org/10.1093/biostatistics/kxm045>
- Gao, J., Song, W., Zhong, Y., Huang, D., Wang, J., Zhang, A., & Ke, X. (2024). Children with developmental coordination disorders: A review of approaches to assessment and intervention. *Frontiers in Neurology*, 15, 1359955. <https://doi.org/10.3389/fneur.2024.1359955>
- Gold, J.I., & Shadlen, M.N. (2007). The neural basis of decision making. *Annual Review of Neuroscience*, 30, 535–574. <https://doi.org/10.1146/annurev.neuro.29.051605.113038>
- Guell, X., Schmahmann J.D., Gabrieli, J.D.E., Ghosh, S.S. (2018). Functional gradients of the cerebellum. *eLife*, 7, e36652. <https://doi.org/10.7554/eLife.36652>
- Gupta, A., Bansal, R., Alashwal, H., Kacar, A.S., Balci, F., & Moustafa, A.A. (2022). Neural substrates of the Drift-Diffusion Model in brain disorders. *Frontiers in Computational Neuroscience*, 15:678232. <https://doi.org/10.3389/fncom.2021.678232>
- Iosif, C.I., Bashir, Z.I., Apps, R., & Pickford, J. (2023). Cerebellar prediction and feeding behaviour. *Cerebellum*, 22(5), 1002-1019. <https://doi.org/10.1007/s12311-022-01476-3>
- Kasatkin, V., Deviaterikova, A., Shurupova, M., & Karelin, A. (2022). The feasibility and efficacy of short-term visual-motor training in pediatric posterior fossa tumor survivors. *European Journal of Physical and Rehabilitation Medicine*, 58(1), 51. <https://doi.org/10.23736/S1973-9087.21.06854-4>
- Kim, S.E., Jung, S., Sung, G., Bang, M., & Lee, S.-H. (2021). Impaired cerebro-cerebellar white matter connectivity and its associations with cognitive function in patients with schizophrenia. *NPJ Schizophrenia*, 7, 38. <https://doi.org/10.1038/s41537-021-00169-w>
- Kirichenko, L., Baranovskii, A., & Kobitskaia, Yu. (2016). Rekurrentnyi analiz samopodobnykh i multifraktal'nykh vremennykh riadov [Recurrence analysis of self-similar and multifractal time series]. *Information Content and Processing*, 3(1), 16–37.

- Kiselev, V.B. (2006). Rekurrentnyi analiz - teoriia i praktika [Recurrent analysis - theory and practice]. *Nauchno-tekhnicheskii vestnik informatsionnykh tekhnologii, mekhaniki i optiki* [Scientific and Technical Bulletin of Information Technologies, Mechanics and Optics], 29, 132–141.
- Kofler, M.J., Spiegel, J.A., Soto, E.F., Irwin, L.N., Wells, E.L., & Austin, K.E. (2019). Do working memory deficits underlie reading problems in attention-deficit/hyperactivity disorder (ADHD)? *Journal of Abnormal Child Psychology*, 47(3), 433–446. <https://doi.org/10.1007/s10802-018-0447-1>
- Koziol, L.F., Budding, D.E., & Chidekel, D. (2012). From movement to thought: Executive function, embodied cognition, and the cerebellum. *Cerebellum*, 11(2), 505–525. <https://doi.org/10.1007/s12311-011-0321-y>
- LaCombe, D., Jr., & Barenholtz, E. (2015). Task decoding using recurrence quantification analysis of eye movements. *Journal of Vision*, 15(12), 1271. <https://doi.org/10.1167/15.12.1271>
- Litovchenko, A.I. (2012). Narusheniia rechi pri opukholiakh mozzhechka (obzor literatury) [Verbal disorders at cerebellar tumors (Literature review)]. *Ukains'kyi neiohkirurhichnyi zhurnal* [Ukrainian Neurosurgical Journal], 2, 4–7. <https://doi.org/10.25305/unj.59039>
- Marusak, H.A., Iadipaolo, A.S., Harper, F.W., Elrahal, F., Taub, J.W., Goldberg, E., & Rabinak, C.A. (2018). Neurodevelopmental consequences of pediatric cancer and its treatment: Applying an early adversity framework to understanding cognitive, behavioral, and emotional outcomes. *Neuropsychology Review*, 28(2), 123–175. <https://doi.org/10.1007/s11065-017-9365-1>
- Myers, C.E., Interian, A., & Moustafa, A.A. (2022). A practical introduction to using the drift diffusion model of decision-making in cognitive psychology, neuroscience, and health sciences. *Frontiers in Psychology*, 13, 1039172. <https://doi.org/10.3389/fpsyg.2022.1039172>
- National Research University Higher School of Economics (n.d.) *International Laboratory for Applied Network Research (ANR-Lab)*. Retrieved March 20, 2026, from <https://anr.hse.ru/en/>
- Nguyen, K.P., Josić, K., & Kilpatrick, Z.P. (2019). Optimizing sequential decisions in the drift-diffusion model. *Journal of Mathematical Psychology*, 88, 32–47. <https://doi.org/10.1016/j.jmp.2018.11.001>
- Pelzer, E.A., Melzer, C., Timmermann, L., von Cramon, D.Y., & Tittgemeyer, M. (2017). Basal ganglia and cerebellar interconnectivity within the human thalamus. *Brain Structure and Function*, 222(1), 381–392. <https://doi.org/10.1007/s00429-016-1223-z>
- Peng, P., Barnes, M., Wang, C., Wang, W., Li, S., Swanson, H.L., Dardick, W., & Tao, S. (2018). A meta-analysis on the relation between reading and working memory. *Psychological Bulletin*, 144(1), 48–76. <https://doi.org/10.1037/bul0000124>
- Ratcliff, R., & McKoon, G. (2008). The diffusion decision model: Theory and data for two-choice decision tasks. *Neural Computation*, 20(4), 873–922. <https://doi.org/10.1162/neco.2008.12-06-420>
- Rayner, K., Chace, K.H., Slattery, T.J., & Ashby, J. (2006). Eye movements as reflections of comprehension processes in reading. *Scientific Studies of Reading*, 10(3), 241–255. [https://doi.org/10.1207/s1532799xssr1003\\_3](https://doi.org/10.1207/s1532799xssr1003_3)
- Rimrodt, S.L., Clements-Stephens, A.M., Pugh, K.R., Courtney, S.M., Gaur, P., Pekar, J.J., & Cutting, L.E. (2009). Functional MRI of sentence comprehension in children with dyslexia: Beyond word recognition. *Cerebral Cortex*, 19(2), 402–413. <https://doi.org/10.1093/cercor/bhn092>
- Sarver, D.E., Rapport, M.D., Kofler, M.J., Scanlan, S.W., Raiker, J.S., Altro, T.A., & Bolden, J. (2012). Attention problems, phonological short-term memory, and visuospatial short-term memory: Differential effects on near- and long-term scholastic achievement. *Learning and Individual Differences*, 22(1), 8–19. <https://doi.org/10.1016/j.lindif.2011.09.010>
- Savage, R., Lavers, N., & Pillay, V. (2007). Working memory and reading difficulties: What we know and what we don't know about the relationship. *Educational Psychology Review*, 19(2), 185–221. <https://doi.org/10.1007/s10648-006-9024-1>
- Schmahmann, J.D., Weilburg, J.B., & Sherman, J.C. (2007). The neuropsychiatry of the cerebellum – insights from the clinic. *Cerebellum*, 6(3), 254–267. <https://doi.org/10.1080/14734220701490995>
- Shinn, M., Lam, N. (2018) *PyDDM - Generalized drift-diffusion models for Python* (Version 0.9.0) [Computer software]. GitHub. <https://github.com/mwshinn/PyDDM.git>

- Shmukler, A.B., Kostiuk, G.P., Latanov, A.V., Sidorova, M.Iu., Anisimov, V.N., Zakharova, N.V., Kariakina, M.V., Reznik, A.M., Sokolov, A.V., Spektor, V.A., Sukhachevskii, I.S., & Churikova, M.A. (2020). Setevoi analiz kognitivnykh, glazodvigatel'nykh i rechevykh pokazatelei pri shizofrenii [Network analysis of cognitive, eye movement, and speech indicators in schizophrenia]. *Zhurnal nevrologii i psikiatrii im. S.S. Korsakova* [S.S. Korsakov Journal of Neurology and Psychiatry], 120(6–2), 54–60. <https://doi.org/10.17116/jnevro202012006254>
- Sokolov, A.A., Miall, R.C., & Ivry, R.B. (2017). The cerebellum: Adaptive prediction for movement and cognition. *Trends in Cognitive Sciences*, 21(5), 313–332. <https://doi.org/10.1016/j.tics.2017.02.005>
- Stoodley, C.J., & Schmahmann, J.D. (2010). Evidence for topographic organization in the cerebellum of motor control versus cognitive and affective processing. *Cortex*, 46(7), 831–844. <https://doi.org/10.1016/j.cortex.2009.11.008>
- Strick, P.L., Dum, R.P., & Fiez, J.A. (2009). Cerebellum and nonmotor function. *Annual review of neuroscience*, 32, 413–434. <https://doi.org/10.1146/annurev.neuro.31.060407.125606>
- Tanedo, J., Gajawelli, N., Guo, S., Baron Nelson, M., & Lepore, N. (2022). White matter tract changes in pediatric posterior fossa brain tumor survivors after surgery and chemotherapy. *Frontiers in Neuroimaging*, 1, 845609. <https://doi.org/10.3389/fnimg.2022.845609>
- Tomaiuolo, F., Cerasa, A., Lerch, J.P., Bivona, U., Carlesimo, G.A., Ciurli, P., Raffa, G., Quattropiani, M.C., Germanò, A., Caltagirone, C., Formisano, R., & Nigro, S. (2021). Brain neurodegeneration in the chronic stage of the survivors from severe non-missile traumatic brain injury: A voxel-based morphometry within-group at one versus nine years from a head injury. *Journal of Neurotrauma*, 38(2), 283–290. <https://doi.org/10.1089/neu.2020.7203>
- Tschense, M., & Wallot, S. (2020). Nonlinear dynamics of text reading: Recurrence quantification analysis of eye movements. *EasyChair Preprints*, 1–15.
- Turner, B.M., Rodriguez, C.A., Norcia, T.M., McClure, S.M., & Steyvers, M. (2016). Why more is better: Simultaneous modeling of EEG, fMRI, and behavioral data. *NeuroImage*, 128, 96–115. <https://doi.org/10.1016/j.neuroimage.2015.12.030>
- van Borkulo, C.D., van Bork, R., Boschloo, L., Kossakowski, J.J., Tio, P., Schoevers, R.A., Borsboom, D., & Waldorp, L.J. (2023). Comparing network structures on three aspects: A permutation test. *Psychological Methods*, 28(6), 1273–1285. <https://doi.org/10.1037/met0000476>
- Velichkovsky B.B., Sultanova F.R., Tatarinov D.V., & Kachina A.A. (2020). Diffuzionnaia model' vremeni reaktzii na nedavnie negativnye proby [Diffusion model of reaction time to recent negative stimuli]. *Eksperimental'naia psikhologiya* [Experimental Psychology], 13(1), 35–50. <https://doi.org/10.17759/exppsy.2020130103>
- Voronin, I.A., Zakharov, I.M., Tabueva, A.O., & Merzon, L.A. (2020). Diffuznnaia model' priniatii resheniia: otsenka skorosti i tochnosti otvetov v zadachakh vybora iz dvukh al'ternativ v issledovaniiaakh kognitivnykh protsessov i sposobnostei [A diffusion decision-making model: Estimating speed and accuracy of responses in two-alternative choice tasks in studies of cognitive processes and abilities]. *Teoreticheskaia i eksperimental'naia psikhologiya* [Theoretical and Experimental Psychology], 13(2), 6–23.
- Voss, A., Voss, J., & Lerche, V. (2015). Assessing cognitive processes with diffusion model analyses: a tutorial based on fast-dm-30. *Frontiers in Psychology*, 6, 336. <https://doi.org/10.3389/fpsyg.2015.00336>
- Zakharov, I.M., & Ismatullina, V.I. (2021). Vzaimosviaz' parametrov diffuznoi modeli priniatii resheniia v zadachakh na kognitivnyi kontrol' i urovnia proizvol'nogo kontrolia [Interrelation between parameters of the diffusion decision-making model in tasks on cognitive control and level of voluntary control]. *Differentsial'naia psikhologiya i psikhofiziologiya segodnia: sposobnosti, obrazovanie, professionalism* [Differential Psychology and Psychophysiology Today: Abilities, Education, Professionalism], 1(1), 425–429.
- Zhuikov, A.A. (2021). Kolichestvennyi analiz rekurrentnosti prosodicheskikh kharakteristik rechevogo signala v sistemakh obucheniiia proiznosheniiu: vypusknnaia kvalifikatsionnaia rabota magistra [Recurrence quantification analysis of prosodic characteristics of a speech signal in computer-assisted

- pronunciation training systems] [Master's thesis, Peter the Great St. Petersburg Polytechnic University]
- Zhuravlev, M.O., Novikov, M.Yu., Sel'skii, A.O., & Runnova, A.E. Statisticheskii analiz kharakteristik rekkurrentnogo analiza razlichnykh stadii sna [Statistical analysis of recurrence analysis characteristics of different sleep stages]. In A.N. Kalish (Ed.), *XXXIV Vserossiiskaia shkola-seminar "Volnovye iavleniia: fizika i primeneniia" (Volny-2023). "Bio- i meditsinskie prilozheniia volnovoi fiziki": Trudy [XXXIV All-Russian School-Seminar "Wave Phenomena: Physics and Applications" (Waves-2023) "Bio- and Medical Applications of Wave Physics": proceedings]*. (pp. 22–27). Moskovskii gosudarstvennyi universitet imeni M.V. Lomonosova, Fizicheskii fakul'tet.
- Zilli, T., Dolcemascolo, V., Passone, E., Maieron, M., De Colle, M. C., Skrap, M., Ius, T., Liguoro, I., Venchiarutti, M., Cogo, P., & Tomasino, B. (2021). A multimodal approach to the study of children treated for posterior fossa tumor: A review of the literature and a pilot study. *Clinical Neurology and Neurosurgery*, 207, 106819. <https://doi.org/10.1016/j.clineuro.2021.106819>

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# Appendix

**Table 1**  
Correlations for Control Group (Age Variable Removed)

	Age	SpLen	Att	TotErr	Time-Last	drift	boundary	NonDecTime	RR Mean	Lam Mean	Lam SD	Ent Mean
Age	1.00	-.02	.61***	.04	.07	.49***	.02	.36**	.18	.16	.32*	.40**
SpLen	-.02	1.00	-.05	-.02	-.15	-.15	-.07	-.11	.13	-.18	.05	-.04
Att	.61***	-.05	1.00	.16	-.55***	.34**	.07	.31*	.18	.02	.28*	.18
TotErr	.04	-.02	.16	1.00	-.21	.30*	.22	-.13	.04	-.02	.04	-.03
TimeLast	.07	-.15	-.55***	-.21	1.00	-.10	-.04	-.09	-.11	.13	-.06	.05
Drift	.49***	-.15	.34**	.30*	-.10	1.00	-.09	.30*	.16	-.04	.23	.23
boundary	.02	-.07	.07	.22	-.04	-.09	1.00	-.14	-.23	.32*	-.20	-.02
NonDecTime	.36**	-.11	.31*	-.13	-.09	.30*	-.14	1.00	.88***	-.31*	.81***	.20
RR Mean	.18	.13	.18	.04	-.08	.32*	-.05	.88***	1.00	-.09	.68***	.42***
Lam Mean	.16	-.18	.02	-.02	.33**	.32*	-.05	.58***	1.00	-.68***	.88***	-.12
Lam SD	.32*	.05	.28*	.04	-.06	.23	-.20	.68***	.88***	1.00	-.48***	.47***
Ent Mean	.40**	-.04	.18	-.03	.05	.23	-.02	.42***	-.12	.47***	.13	1.00

Notes: Level of significance: \*  $p < .05$ , \*\*  $p < .01$ . Abbreviations: Drift- drift rate; boundary - decision boundary; NonDecTime - non-decision time; SpLen - span length of SSP test; Att - number of attempts in SSP test; TotErr - total errors of SSP test; TimeLast - mean time of last response in SSP test; RR Mean- mean of recurrence rate; RR SD - standard deviation of recurrence rate; Lam Mean - mean of laminarity; Lam SD - standard deviation of laminarity; Ent Mean - mean of entropy; Ent SD - standard deviation of entropy.

**Table 2**  
Correlations for Patients' Group with Clinical Factors (Age Variable Removed)

	Age	SpLen	Att	TotErr	Time-Last	drift	boun- dary	NonDec Time	RR Mean	Lam Mean	Lam SD	Ent Mean	Age onset	Treat- ment months	Remis- sion months
Age	1.00	-.12	.42***	-.10	.28*	.23	-.04	.24	.19	.13	.11	.24*	.10	.03	-.17
SpLen	-.12	1.00	-.02	-.14	-.02	.03	.44***	.17	.08	-.03	.06	-.10	-.10	.07	.11
Att	.42***	-.02	1.00	-.06	-.47***	.15	.01	.17	.21	.18	.20	.26*	.10	.17	-.10
TotErr	-.10	-.14	-.06	1.00	.00	.11	.02	.09	.14	-.03	.10	-.06	.11	-.10	-.06
TimeLast	.28*	-.02	-.47***	.00	1.00	-.16	-.15	.03	-.02	-.02	-.10	.06	-.11	-.13	.07
Drift	.23	.03	.15	.11	-.16	1.00	.03	-.03	.01	.01	.02	.01	.08	.18	-.15
boundary	-.04	.44***	.01	.02	-.15	.03	1.00	.13	.06	.00	-.01	-.09	-.04	-.07	.07
NonDecTime	.24	.17	.17	.09	.03	-.03	.13	1.00	.92***	.14	.72***	.51***	.12	-.17	-.08
RR Mean	.19	.08	.21	.14	-.02	.01	.06	.92***	1.00	.25*	.65***	.58***	.22	-.13	-.16
RR SD	.00	.03	.11	.04	-.09	.07	-.04	.41***	.34**	-.68***	.77***	-.05	-.17	.12	.15
Lam Mean	.13	-.03	.18	-.03	-.02	.01	.00	.14	.25*	1.00	-.30*	.55***	.24	-.08	-.22
Lam SD	.11	.06	.20	.10	-.10	.02	-.01	.72***	.77***	-.30*	1.00	.32**	-.05	-.01	.05
Ent Mean	.24*	-.10	.26*	-.06	.06	.01	-.09	.51***	.58***	.32**	1.00	1.00	.27*	.05	-.33**
Age onset	.10	-.10	.10	.11	-.11	.08	-.04	.12	.22	.24	-.05	.27*	1.00	-.01	-.92***
Treatment months	.03	.07	.17	-.10	-.13	.18	-.07	-.17	-.13	-.08	-.01	.05	-.01	1.00	-.25*
Remission months	-.17	.11	-.10	-.06	.07	-.15	.07	-.08	-.16	-.22	.05	-.33**	-.92***	-.25*	1.00

Notes. Level of significance: \*  $p < .05$ , \*\*  $p < .01$ . Abbreviations: Drift - drift rate; boundary - decision boundary; NonDecTime - non-decision time; SpLen - span length of SSP test; Att - number of attempts in SSP test; TotErr - total errors of SSP test; TimeLast - mean time of last response in SSP test; RR Mean - mean of recurrence rate; RR SD - standard deviation of recurrence rate; Lam Mean - mean of laminaryity; Lam SD - standard deviation of laminaryity; Ent Mean - mean of entropy; Ent SD - standard deviation of entropy; AgeOnset - age at disease onset; Treatment months - duration of treatment; remission months - duration of remission.

**Table 3***Strength of Nodes for Control Group*

<b>Node</b>	<b>Strength</b>
Bound	.46
Laminarity <i>SD</i>	.39
Span length	.58
Entropy <i>SD</i>	.32
Nondectime	.20
Laminarity mean	.77
Attempts	.00
Mean time last response	.00
Entropy mean	.87
Recurrence rate mean	.79
Recurrence rate <i>SD</i>	.78
Drift	.27
Total errors	.47

**Table 4***Strength of Nodes for Patient Group without Clinical Factors*

<b>Node</b>	<b>Strength</b>
Span length	.48
Recurrence rate mean	.89
Entropy <i>SD</i>	.57
Attempts	.00
Mean time last response	.00
Nondectime	.00
Bound	.05
Recurrence rate <i>SD</i>	.92
Entropy mean	.88
Laminarity <i>SD</i>	.67
Drift	.48
Total errors	.50
Laminarity mean	.76

**Table 5***Strength of Nodes for Patient Group with Clinical Factors*

<b>Node</b>	<b>Strength</b>
Span length	.73
Recurrence rate mean	.94
Laminarity <i>SD</i>	.75
Entropy <i>SD</i>	.90
Remission months	.20
Recurrence rate <i>SD</i>	.97
Bound	.10
Entropy mean	.92
Laminarity mean	.86
Drift	.64
Total errors	.72

## CLINICAL PSYCHOLOGY

# The Protective Role of Vigor in Volunteering Against Somatic and Psychological Symptoms in EMDR Therapists

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**Background.** Empirical evidence highlights that psychotherapists and applied psychologists experience stress, anxiety, depression, emotional exhaustion, secondary traumatic stress, and other symptoms of somatic and psychological distress. Although studies suggest that volunteering can protect somatic and psychological well-being in the general population, these relationships have not been investigated in mental health professionals.

**Objective.** This study aimed to examine the role of volunteering and work-related characteristics in symptoms of somatic and psychological distress among psychotherapists and applied psychologists.

**Design.** The study had a cross-sectional design. The participants were psychotherapists and applied psychologists who provided volunteer Eye Movement Desensitization and Reprocessing (EMDR) therapy sessions. One hundred and twenty volunteer EMDR therapists filled out the forms measuring somatic, anxiety, and depressive symptoms, job satisfaction, meaningfulness of work, and engagement in volunteering.

**Results.** Correlation analyses showed that symptoms of somatic and psychological distress were negatively associated with job satisfaction, vigor in volunteering, and dedication in volunteering. Regression analyses revealed that vigor in volunteering was the only significant negative predictor of somatic ( $\beta = -.247, p = .049$ ), anxiety ( $\beta = -.263, p = .004$ ), and depressive symptoms ( $\beta = -.263, p = .034$ ).

**Conclusion.** This study contributes to our knowledge of the benefits of volunteering for the somatic and psychological well-being of EMDR therapists. From a practical standpoint, these findings suggest that psychotherapists and applied psychologists might be encouraged to frame pro bono work as a form of emotional and professional self-regulation. Furthermore, training programs could integrate pro bono activities into their curricula.

**Keywords:**  
anxiety, applied psychology, depression, psychotherapy, somatic symptoms

## **Introduction**

The mental and physical health of psychotherapists and applied psychologists is attracting increasing attention from researchers and practitioners. Empirical evidence highlights the fragility of mental well-being among these professionals: studies report an incidence of 5% for insomnia, 20% for stress, 8% for anxiety and depressive symptoms (Schaffler et al., 2024), as well as 40% for emotional exhaustion, 22% for depersonalization, and 19% for low levels of personal accomplishment (O'Connor et al., 2018). Between 19% and 81% of mental health professionals report a history of personal trauma, and between 19% and 70% exhibit symptoms of secondary traumatic stress (Henderson et al., 2025). Many practitioners complained of somatic symptoms including headaches, back pain, and gastroenteritis (Raquepaw & Miller, 1989; Rupert & Kent, 2007). Collectively, these findings indicate that psychotherapists and applied psychologists experience a high somatic and psychological burden.

The abundance of somatic and psychological symptoms is a common reason for the intention to leave the psychotherapeutic practice and profession (Garcia et al., 2014; Rosenberg & Pace, 2006). Thus, one-third of practitioners reported a strong intention to leave working as a psychotherapist in the current or near future (Aminihajibashi et al., 2022). Psychological factors associated with practitioners' intention to leave the profession include physical and psychological exhaustion stemming from personal life, work demands, and client interactions, as well as job dissatisfaction, disturbances in professional identity, and diminished work engagement (Roth et al., 2024). Notably, somatic and psychological distress appear to play a particularly salient role in intentions to leave the profession among younger and less experienced psychotherapists and applied psychologists, who typically have not yet developed the capacity to conserve their emotional energy (McCormack et al., 2018).

Thus, ensuring the well-being of psychotherapists and applied psychologists emerges as an ethical and professional imperative. Recent findings indicate that over half of practicing psychiatrists express regret regarding their career choice, stating they would not select psychiatry again if afforded the chance (Gu et al., 2023). In light of these concerns, researchers have focused on identifying protective factors that may mitigate somatic and psychological distress among mental health professionals and reduce their risk of professional attrition. This growing body of work suggests that higher levels of self-compassion (McCade et al., 2021), compassion satisfaction (Aminihajibashi et al., 2022), psychological well-being (Van Hoy & Rzeszutek, 2022), personal accomplishment (McCormack et al., 2018), psychological resources (Medisauskaite et al., 2023), positive affect, and life satisfaction (Samios, 2018) are associated with greater health benefits and a stronger intention to remain in the psychotherapeutic profession.

Filling a gap in the literature, this study explores volunteering as a potential protective factor for the somatic and psychological well-being of mental health professionals. There is extensive evidence that volunteering is associated with a higher sense of belonging and social connectedness (Luque-Suárez et al., 2021; Musick & Wilson, 2003; Russell et al., 2019); greater self-esteem, happiness, and life satisfaction (Borgonovi, 2008; Morrow-Howell et al., 2003; Thoits & Hewitt,

2001); growing social and human capital (Kragt & Holtrop, 2019); lower loneliness and depressive symptoms (Mayers et al., 2024); less suicidal behavior, premature mortality, and functional impairment (Greenfield & Marks, 2004; Konrath et al., 2012; Rosato et al., 2019). However, evidence for these relationships comes primarily from the general population, and the impact of volunteering on the somatic and psychological well-being of psychotherapists and applied psychologists remains poorly understood.

In view of the foregoing, this study was aimed at examining the role of volunteering and work-related characteristics in symptoms of somatic and psychological distress among psychotherapists and applied psychologists.

## Methods

### *Participants*

The study had a cross-sectional design. In March–April 2023, the Organizing Committee of the Eye Movement Desensitization and Reprocessing (EMDR) Russia Association sent letters to members asking them to fill out an online questionnaire. The assessment was anonymous. All participants provided informed consent prior to participation. The inclusion criteria were: 1) completed training in EMDR therapy; 2) conducted group or individual volunteer EMDR sessions. The exclusion criteria were: 1) incomplete EMDR therapy training; 2) no experience providing group or individual volunteer EMDR sessions.

An *a priori* power analysis was performed using G\*Power 3.1.9.7 to justify the sample size (Kang, 2021). Assuming a medium effect size ( $f^2 = .15$ ), an  $\alpha$  level of .05, and a desired power of .95 for a multiple regression model with ten predictors, the analysis indicated a minimum required sample of 89 participants.

Our final sample of 120 participants exceeded this threshold, thereby providing adequate statistical power for the primary analyses. Among the participants were 111 (93%) women and 9 (7%) men aged 24 to 67 years with work experience in psychology ranging from 1 to 35 years and volunteering experience in EMDR therapy from 1 month to 6 years (see *Table 1*).

### *Measures*

The survey contained socio-demographic questions (sex, age, work experience, and volunteering experience) and the following instruments.

*The Somatic Symptom Scale-8 (SSS-8; Gierk et al., 2014).* The SSS-8 contains 8 items assessing somatic burden based on self-reporting of specific somatic symptoms (e.g., “headaches”, “dizziness”, “trouble sleeping”). Each symptom was examined with the Likert scale from 0 (“not at all”) to 4 (“very much”). We used the Russian version of the SSS-8 (Zolotareva, 2022). The sum score was calculated for the SSS-8, with a possible range from 0 to 32. A cut-off score  $\geq 12$  shows high somatization (Gierk et al., 2014). In this study, Cronbach’s alpha was .75.

*The Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006).* The GAD-7 includes 7 items measuring the severity of anxiety symptomatology on self-reporting of specific anxiety symptoms (e.g., “trouble relaxing”, “feeling afraid as if something

awful might happen”). Each symptom was evaluated with the Likert scale from 0 (“not at all”) to 3 (“nearly every day”). We used the Russian version of the GAD-7 (Zolotareva, 2023a). The sum score was calculated for the GAD-7, with a possible range from 0 to 21. A cut-off score  $\geq 10$  indicates high anxiety (Spitzer et al., 2006). In this study, Cronbach’s alpha was .81.

*The Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001)*. The PHQ-9 contains 9 items assessing the severity of depressive symptomatology on self-reporting of specific depressive symptoms (e.g., “feeling tired or having little energy”, “trouble falling asleep or sleeping too much”). Each symptom was examined with the Likert scale from 0 (“not at all”) to 3 (“nearly every day”). We used the Russian version of the PHQ-9 (Zolotareva, 2023b). The sum score was calculated for the PHQ-9, with a possible range from 0 to 27. A cut-off score  $\geq 10$  shows high depression (Kroenke et al., 2001). In this study, Cronbach’s alpha was .73.

*The Short Index of Job Satisfaction (SIJS; Judge et al., 2000)*. The SIJS includes 5 items measuring general job satisfaction (e.g., “Most days I am enthusiastic about my work”). Each item was evaluated with the Likert scale from 1 (“strongly disagree”) to 5 (“strongly agree”). In this study, we translated the SIJS into Russian and examined its internal consistency (Cronbach’s alpha was .56). The sum score was calculated for the SIJS, with a possible range from 5 to 25.

*The Work and Meaning Inventory (WAMI; Steger et al., 2012)*. The WAMI contains 10 items assessing positive meaning (4 items to assess the degree to which people find meaning and purpose in their work, e.g., “I have found a meaningful career”), meaning-making through work (3 items to examine the attitude towards work as something broader and meaningful, e.g., “My work helps me make sense of the world around me”), and greater good motivations (3 items to evaluate the awareness that one’s own work benefits society and others, e.g., “The work I do serves a greater purpose”). Each item was examined with the Likert scale from 1 (“absolutely untrue”) to 5 (“absolutely true”). In this study, we translated the WAMI and examined its internal consistency (Cronbach’s alphas were .69, .66, and .58 for positive meaning, meaning-making through work, and greater good motivations, respectively).

*The Utrecht Work Engagement Scale (UWES-9; Schaufeli et al., 2006)*. The UWES-9 includes 9 items measuring vigor (3 items to assess feeling full of energy at work), dedication (3 items to examine the involvement in the work), and absorption (3 items to evaluate the happy immersion in work). Each item was evaluated with the Likert scale from 0 (“never”) to 6 (“always/every day”). We used the Russian version of the UWES-9 (Lovakov et al., 2017). For the aims of this study, we modified the instruction and asked the respondents to examine their engagement in volunteering (e.g., “My volunteering makes me feel strong and vigorous”, “My volunteering inspires me”, “I feel happy when I am volunteering intensely”). In this study, Cronbach’s alphas were .76, .79, and .72 for vigor, dedication, and absorption, respectively.

### **Data analysis**

There were four stages of data analysis. First, we assessed the normality of the distribution using the Shapiro-Wilk test (Kim, 2013). Most variables exhibited a non-normal distribution. Second, we examined Cronbach’s alphas for the study variables.

Since all variables were measured by less than 10 items, Cronbach's alphas  $> .5$  were considered acceptable (Pallant, 2010). Third, we calculated medians for continuous variables and frequencies and percentages for categorical variables. Fourth, we used correlation analyses and multiple regression analyses to examine the relationships between study variables. The relationships were considered significant at  $p < .05$ . Statistical analyses were conducted using Jamovi 2.6.26 and JASP 0.19.3.0.

## Results

Table 1 shows the descriptive statistics of the participants.

**Table 1**

*Descriptive statistics of the participants*

Characteristics	M	SD	Me	Skew	Kurt	SW-test
Age, years	41.6	8.16	40	.76	.87	.952 ( $p < .001$ )
Work experience, months	118	96.6	84	1.06	.30	.878 ( $p < .001$ )
Volunteering experience, months	11.5	12.8	8	2.18	5.48	.735 ( $p < .001$ )
Job satisfaction	22.2	1.96	22	.66	.38	.939 ( $p < .001$ )
Positive meaning of work	18.9	1.52	20	1.69	.44	.745 ( $p < .001$ )
Meaning-making through work	14	1.45	15	1.27	.59	.726 ( $p < .001$ )
Greater good work motivations	13.8	1.51	14	1.28	1.25	.784 ( $p < .001$ )
Vigor in volunteering	12.8	2.5	13	.42	.31	.692 ( $p = .002$ )
Dedication in volunteering	15.3	2.26	16	1.18	1.83	.897 ( $p < .001$ )
Absorption in volunteering	13.3	2.69	14	.29	.07	.968 ( $p = .006$ )
Somatic symptoms	7.06	4.91	6	.76	.16	.943 ( $p < .001$ )
Anxiety symptoms	3.16	2.83	3	2.33	10.2	.816 ( $p < .001$ )
Depressive symptoms	4.58	3.30	4	1.15	1.09	.897 ( $p < .001$ )

*Note.* Sum scores were calculated for all variables. *M* = mean; *SD* = standard deviation; *Me* = median; *Skew* = skewness; *Kurt* = kurtosis; *SW-test* = Shapiro-Wilk test. The standard error of skewness is .22; the standard error of kurtosis is .44.

Generally, 3% of respondents had anxiety, 9% had depression, and 19% had somatization. The prevalence of specific symptoms ranged from 15% (chest pain or shortness of breath) to 87% (feeling tired or having low energy) for somatic symptoms; from 13% (restless) to 72% (nervous, anxious, on edge) for anxiety symptoms; and from 6% (suicidal thoughts) to 82% (tired or little energy) for depressive symptoms.

Correlation analyses revealed the following patterns. Somatic symptoms were positively associated with age, meaning-making through work, and greater good work motivations, and negatively associated with work experience, volunteering experience, job satisfaction, as well as vigor, dedication, and absorption in volunteering. Anxiety symptoms were positively associated with meaning-making through work and negatively associated with age, work experience, volunteering experience, job

satisfaction, and vigor, dedication, and absorption in volunteering. Depressive symptoms were positively associated with age and negatively associated with job satisfaction, positive meaning of work, and vigor, dedication, and absorption in volunteering. Table 2 illustrates these patterns.

**Table 2**

*Associations of somatic, anxiety, and depressive symptoms with volunteering, job satisfaction, and job meaningfulness among EMDR therapists*

Characteristics	Somatic symptoms	Anxiety symptoms	Depressive symptoms
Age, years	.074 (p = .420)	-.081 (p = .379)	.064 (p = .490)
Work experience, months	-.055 (p = .552)	-.100 (p = .279)	-.018 (p = .842)
Volunteering experience, months	-.072 (p = .435)	-.095 (p = .303)	-.031 (p = .738)
Job satisfaction	-.286 (p = .002)	-.185 (p = .044)	-.329 (p < .001)
Positive meaning of work	.009 (p = .926)	.009 (p = .920)	-.078 (p = .396)
Meaning-making through work	.108 (p = .242)	.074 (p = .421)	.024 (p = .796)
Greater good work motivations	.043 (p = .637)	.031 (p = .739)	.017 (p = .852)
Vigor in volunteering	-.324 (p < .001)	-.263 (p = .004)	-.353 (p < .001)
Dedication in volunteering	-.244 (p = .007)	-.173 (p = .059)	-.263 (p = .004)
Absorption in volunteering	-.180 (p = .049)	-.067 (p = .467)	-.145 (p = .115)

Given the exploratory nature of the study and the limited sample size, only predictors showing a statistically significant bivariate correlation with the dependent variable and demonstrating at least a small effect size ( $|r| \geq .20$ ) were entered into the regression model to avoid overfitting and ensure model parsimony.

*Model 1* examined job satisfaction, vigor in volunteering, and dedication in volunteering as predictors of somatic symptoms. Tolerance values were above .40 and VIF values were below 2.50 for all predictors, indicating no evidence of multicollinearity. The regression model was statistically significant ( $F_{[3, 116]} = 5.282, p = .002; R^2 = .120, \text{adjusted } R^2 = .097$ ). Vigor in volunteering had a significant effect on somatic symptoms.

*Model 2* assessed vigor in volunteering as a predictor of anxiety symptoms. As only a single predictor was included in the model, multicollinearity was not a concern. The regression model was statistically significant ( $F_{[1, 118]} = 8.791, p = .004; R^2 = .069, \text{adjusted } R^2 = .061$ ). Vigor in volunteering was negatively associated with somatic symptoms.

*Model 3* examined job satisfaction, vigor in volunteering, and dedication in volunteering as predictors of depressive symptoms. Tolerance values were above .40 and VIF values were below 2.50 for all predictors, indicating no evidence of multicollinearity. The regression model was statistically significant ( $F_{[3, 116]} = 6.777, p < .001; R^2 = .149, \text{adjusted } R^2 = .127$ ). Vigor in volunteering had a significant effect on depressive symptoms.

Table 3 illustrates these relationships.

**Table 3***Predictors of somatic, anxiety and depressive symptoms*

Model	B	SE	95% CI	t-value	p-value	tolerance	VIF
<i>Model 1: Predictors of somatic symptoms</i>							
Job satisfaction	-.155	.282	(-.945; .171)	-1.373	.172	.598	1.674
Vigor in volunteering	-.247	.244	(-.970; .002)	-1.988	.049	.491	2.039
Dedication in volunteering	.017	.276	(-.510; .583)	.132	.895	.472	2.120
<i>Model 2: Predictors of anxiety symptoms</i>							
Vigor in volunteering	-.263	.101	(-.498; .099)	-2.965	.004	n/a	n/a
<i>Model 3: Predictors of depressive symptoms</i>							
Job satisfaction	-.200	.186	(-.706; .032)	-1.807	.073	.598	1.674
Vigor in volunteering	-.263	.162	(-.668; .027)	-2.150	.034	.491	2.039
Dedication in volunteering	.036	.182	(-.309; .414)	.287	.774	.472	2.120

Note.  $\beta$  = beta standardized; n/a = not applicable.

## Discussion

This study aimed to examine the role of volunteering and work-related characteristics in somatic and psychological distress among psychotherapists and applied psychologists.

We found that 3% of EMDR therapists had anxiety symptoms, 9% reported depressive symptoms, and 19% complained of somatic symptoms. These values were much lower than 25-43% for anxiety symptoms and 25-45% for depressive symptoms but were within a wide range of 8-68% for somatic symptoms in health care workers during the COVID-19 pandemic (Chen et al., 2022; Sahebi et al., 2021; Theocharis et al., 2023). Moreover, these values were lower than the 35% for anxiety symptoms and 27% for depressive symptom in medical students volunteering in the first months of the pandemic in Spain (Gómez-Durán et al., 2022). We believe that the low prevalence of mental health problems may be the result of not just volunteering, but of the high degree of mental health literacy and self-care among the medical students. In the general population, adequate mental health literacy decreased the risks of anxiety and depressive symptoms (Huang et al., 2021).

Greater vigor in volunteering was associated with fewer somatic, anxiety, and depressive symptoms. This relationship can be explained by at least three underlying mechanisms.

One potential mechanism involves the vigor in volunteering acting as a protective factor against burnout, which contributes to somatic and psychological distress. Recent research suggests that volunteering may be beneficial in preventing emotional burnout in healthcare workers and students, but may offer little benefit to those already suffering from it (Metzger et al., 2024). Burnout is strongly linked to anxiety and depression and can present with a range of somatic symptoms including fatigue, back pain, joint or limb pain, trouble sleeping, headaches, and alternating diarrhea

or constipation (Gu et al., 2024; Hammarström et al., 2023). Therefore, volunteering may reduce somatic and psychological distress among psychotherapists and applied psychologists by preventing burnout. In contrast to routine clinical practice, volunteer counseling sessions are oriented toward collective restoration, fostering participants' sense of belonging to a broader community (Sandberg et al., 2024).

Another possible mechanism is that volunteering helps psychotherapists and applied psychologists move beyond rigid role boundaries. By offering psychological support on a pro bono basis, they can renew their faith in the value of their profession and human connections, thereby developing and strengthening their professional identity. Similar processes underlie the formation of social and personality identities among volunteers (Camia et al., 2024; Gray & Stevenson, 2020; Wakefield et al., 2022). Rooted in values such as acceptance, autonomy and empowerment, honesty, humility, equality, respect, compassion, tolerance and openness to experience, the identities of mental health professionals are aligned with positive attitudes toward volunteering (Duggal & Sriram, 2021). Collectively, these findings suggest that vigor in volunteering may explain why a stable sense of identity is associated with less somatic and psychological distress (Raemen et al., 2023; Samaey et al., 2025).

Finally, another mechanism linking vigor in volunteering to somatic and psychological well-being may have a neurobiological basis. Evidence suggests that prosocial behavior activates distinct brain systems more robustly than reward-related stimuli (Wang et al., 2019). These systems, implicated in the processing of social information, include the insula, temporal lobe, and superior temporal gyrus. Social reward and positive social interactions contribute to the sense that a person's life is meaningful (Kawamichi et al., 2016). Similar meaning-making processes may operate across other forms of prosocial engagement. For example, psychotherapists report deriving both self-oriented meaning, such as feeling gratified, fulfilled, and connected, and other-oriented meaning, such as helping others and contributing to a better world, from their work (Hill et al., 2017). This suggests that the experience of meaning may be a common psychological mechanism underlying the health benefits of diverse prosocial activities, including volunteering.

Taken together, the proposed mechanisms could help explain how volunteering is associated with somatic and psychological well-being among psychotherapists and applied psychologists, but they need to be examined in future research.

## **Limitations**

This study has several limitations. First, its cross-sectional design precludes causal inferences regarding the role of volunteering in the somatic and psychological well-being of psychotherapists and applied psychologists. Second, the data were based on self-reporting which may be subject to social desirability bias. Third, there is a risk of selection bias, as the mental health professionals who responded to the invitation may have had higher baseline levels of somatic and psychological well-being. Fourth, our sample consisted exclusively of EMDR therapists, which restricts the generalizability of the findings to other groups of psychotherapists and applied psychologists. Fifth, the sample was small and predominantly female, which may explain why many theoretically meaningful associations failed to reach statistical significance.

## **Clinical implications**

The finding that greater engagement in volunteering is associated with somatic and psychological well-being among mental health professionals has clear clinical implications. Psychotherapists and applied psychologists might be encouraged to frame pro bono work not merely as altruistic service but as a form of emotional and professional self-regulation that mitigates burnout and symptoms of somatic and psychological distress. Training programs could integrate pro bono activities into their curricula in order to simultaneously develop clinical competencies, strengthen professional identity, and enhance the sense of meaning in one's professional work. Furthermore, clinics and professional associations may support such engagement, for example, by allocating a portion of clinicians' working hours to providing free consultations to vulnerable populations.

## **Conclusion**

This study provides evidence that greater engagement in volunteering is associated with fewer somatic, anxiety, and depressive symptoms among psychotherapists and applied psychologists. However, given the cross-sectional nature of the data, causal inferences cannot be drawn. The relatively low prevalence of somatic and psychological distress in this sample may reflect the combined protective effects of professional expertise, mental health literacy, and prosocial engagement, yet a reverse causal pathway is also plausible: psychotherapists and applied psychologists in a more favorable psychological state may simply possess the personal resources and time to dedicate to volunteering. These findings underscore the potential role of volunteering not only as a form of social contribution but also as a component of a bidirectional relationship supporting mental health professionals' own somatic and psychological well-being. The mechanisms underlying these relationships, including burnout prevention, professional identity reinforcement, and enhanced sense of meaning in one's work, warrant further longitudinal investigation to clarify the directionality of these effects.

## **Ethics Statement**

The study was approved by the HSE Institutional Review Board (minutes of the meeting of December 13, 2022).

## **Informed Consent from the Participants' Legal Guardians**

Informed consent was obtained from all study participants.

## **Author Contributions**

A.Z. conceived the idea, developed the theory, performed the computations, analyzed the data, and drafted the manuscript. J.V., E.K. gathered the data and discussed the results. All authors have read and agreed to the published version of the manuscript.

## Conflict of Interest

The authors declare no conflict of interest.

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## References

- Aminihajibashi, S., Skar, A.M.S., & Jensen, T.K. (2022). Professional wellbeing and turnover intention among child therapists: a comparison between therapists trained and untrained in Trauma-Focused Cognitive Behavioral Therapy. *BMC Health Services Research*, 22, 1328. <https://doi.org/10.1186/s12913-022-08670-3>
- Borgonovi, F. (2008). Doing well by doing good: The relationship between formal volunteering and self-reported health and happiness. *Social Science and Medicine*, 66(11), 2321–2334. <https://doi.org/10.1016/j.socscimed.2008.01.011>
- Camia, C., Zimmermann, G. & Lischke, M. (2024). Volunteering experiences of young people who experience social marginalization: Examining the impact on their identity and lives. *Journal of Applied Youth Studies*, 7, 399–417. <https://doi.org/10.1007/s43151-024-00131-4>
- Chen, Y., Wang, J., Geng, Y., Fang, Z., Zhu, L., Chen, Y., & Yao, Y. (2022). Meta-analysis of the prevalence of anxiety and depression among frontline healthcare workers during the COVID-19 pandemic. *Frontiers in Public Health*, 10, 984630. <https://doi.org/10.3389/fpubh.2022.984630>
- Duggal, C., & Sriram, S. (2021). Confluence of therapist personal and professional values: How therapist values become signposts for therapeutic trails. *Psychological Studies*, 66, 167–180. <https://doi.org/10.1007/s12646-021-00599-7>
- Garcia, H.A., McGeary, C.A., McGeary, D.D., Finley, E.P., & Peterson, A.L. (2014). Burnout in Veterans Health Administration mental health providers in posttraumatic stress clinics. *Psychological Services*, 11(1), 50–59. <https://doi.org/10.1037/a0035643>
- Gierk, B., Kohlmann, S., Kroenke, K., Spangenberg, L., Zenger, M., Brähler, E., Löwe, B. (2014). The Somatic Symptom Scale-8 (SSS-8): A brief measure of somatic symptom burden. *JAMA Internal Medicine*, 174(3), 399–407. <https://doi.org/10.1001/jamainternmed.2013.12179>
- Gómez-Durán, E.L., Fumadó, C.M., Gassó, A.M., Díaz, S., Miranda-Mendizabal, A., Forero, C. G., Virumbrales, M. (2022). COVID-19 pandemic psychological impact and volunteering experience perceptions of medical students after 2 years. *International Journal of Environmental Research and Public Health*, 19(2), 7532. <https://doi.org/10.3390/ijerph19127532>
- Gray, D., & Stevenson, C. (2020). How can ‘we’ help? Exploring the role of shared social identity in the experiences and benefits of volunteering. *Journal of Community and Applied Social Psychology*, 30(4), 341–353. <https://doi.org/10.1002/casp.2448>
- Greenfield, E.A., & Marks, N.F. (2004). Formal volunteering as a protective factor for older adults’ psychological well-being. *Journal of Gerontology Series B: Psychological Sciences and Social Sciences*, 59(5), 258–264. <https://doi.org/10.1093/geronb/59.5.s258>
- Gu, M., Wang, S., Zhang, S., Song, S., Gu, J., Shi, Y., Li, W., Chen, L., Liang, Y., Yang, Y., Zhang, L., Li, M., Jiang, F., Liu, H., & Tang, Y.-l. (2024). The interplay among burnout, and symptoms of de-

- pression, anxiety, and stress in Chinese clinical therapists. *Scientific Reports*, 14, 25461. <https://doi.org/10.1038/s41598-024-75550-7>
- Gu, M., Zheng, L., Gu, J., Wang, S., Shi, Y., Jiang, F., Liu, H., Tang, Y.-l. (2023). Would you choose to be a psychiatrist again? A large-sample nationwide survey of psychiatrists and psychiatry residents in China. *International Journal of Mental Health Systems*, 17, 43. <https://doi.org/10.1186/s13033-023-00614-6>
- Hammarström, P., Rosendahl, S., Gruber, M., & Nordin, S. (2023). Somatic symptoms in burnout in a general adult population. *Journal of Psychosomatic Research*, 168, 111217. <https://doi.org/10.1016/j.jpsychores.2023.111217>
- Henderson, A., Jewell, T., Huang, X., & Simpson, A. (2025). Personal trauma history and secondary traumatic stress in mental health professionals: A systematic review. *Journal of Psychiatric and Mental Health Nursing*, 32(1), 13–30. <https://doi.org/10.1111/jpm.13082>
- Hill, C.E., Kanazawa, Y., Knox, S., Schauerma, I., Loureiro, D., James, D., Carter, I., King, S., Razzak, S., Scarff, M., & Moore, J. (2017). Meaning in life in psychotherapy: The perspective of experienced psychotherapists. *Psychotherapy Research*, 27(4), 381–396. <https://doi.org/10.1080/10503307.2015.1110636>
- Huang, X., Wang, X., Hu, J., Xue, Y., Wei, Y., Wan, Y., Song, X., Wang, R., Zhang, B., Fang, J., & Zhang, S. (2021). Inadequate mental health literacy and insufficient physical activity potentially increase the risks of anxiety and depressive symptoms in Chinese college students. *Frontiers in Psychiatry*, 12, 753695. <https://doi.org/10.3389/fpsyt.2021.753695>
- Judge, T.A., Bono, J.E., & Locke, E.A. (2000). Personality and job satisfaction: The mediating role of job characteristics. *Journal of Applied Psychology*, 85(2), 237–249. <https://doi.org/10.1037/0021-9010.85.2.237>
- Kang, H. (2021). Sample size determination and power analysis using the G\*Power software. *Journal of Educational Evaluation for Health Professions*, 18, 17. <https://doi.org/10.3352/jeehp.2021.18.17>
- Kawamichi, H., Sugawara, S., Hamano, Y., Makita, K., Kochiyama, T., & Sadato, N. (2016). Increased frequency of social interaction is associated with enjoyment enhancement and reward system activation. *Scientific Reports*, 6, 24561. <https://doi.org/10.1038/srep24561>
- Kim, H.Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry and Endodontics*, 38(1), 52–54. <https://doi.org/10.5395/rde.2013.38.1.52>
- Konrath, S., Fuhrel-Forbis, A., Lou, A., & Brown, S. (2012). Motives for volunteering are associated with mortality risk in older adults. *Health Psychology*, 31(1), 87–96. <https://doi.org/10.1037/a0025226>
- Kragt, D., & Holtrop, D. (2019). Volunteering research in Australia: A narrative review. *Australian Journal of Psychology*, 71(4), 342–360. <https://doi.org/10.1111/ajpy.12251>
- Kroenke, K., Spitzer, R.L., & Williams, J.B.W. (2001). The PHQ-9. Validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>
- Lovakov, A.V., Agadullina, E.R., & Schaufeli, W.B. (2017). Psychometric properties of the Russian version of the Utrecht Work Engagement Scale (UWES-9). *Psychology in Russia: State of the Art*, 10(1), 145–162. <https://doi.org/10.11621/pir.2017.0111>
- Luque-Suárez, M., Olmos-Gómez, M.d.C., Castán-García, M., & Portillo-Sánchez, R. (2021). Promoting emotional and social well-being and a sense of belonging in adolescents through participation in volunteering. *Healthcare (Basel)*, 9(3), 359. <https://doi.org/10.3390/healthcare9030359>
- Mayers, T., Eto, S., Maki, N., Araki, A., & Matsuda, H. (2024). Volunteering and its association with depression, loneliness, and lifestyle of older adults: Insights from a Japanese cross-sectional study. *Healthcare*, 12, 2187. <https://doi.org/10.3390/healthcare12212187>
- McCade, D., Frewen, A., & Fassnacht, D.B. (2021) Burnout and depression in Australian psychologists: The moderating role of self-compassion. *Australian Psychologist*, 56(2), 111–122. <https://doi.org/10.1080/00050067.2021.1890979>
- McCormack, H.M., MacIntyre, T.E., O’Shea, D., Herring, M.P., & Campbell, M.J. (2018). The prevalence and cause(s) of burnout among applied psychologists: A systematic review. *Frontiers in Psychology*, 9, 1897. <https://doi.org/10.3389/fpsyg.2018.01897>

- Medisauskaite, A., Alexander, K., Rich, A., Knight, L., Adesalu, O., & Silkens, M.E.W.M. (2023). To stay or go? A mixed methods study of psychiatry trainees' intentions to leave training. *Journal of Workplace Behavioral Health*, 39(1), 48–66. <https://doi.org/10.1080/15555240.2023.2210286>
- Metzger, T., Nguyen, N., Le, H., Havo, D., Ngo, K., Lee, S., Nguyen, T., Nguyen, Q., Tran, L., Tong, N., Le, C., & Dudovitz, R. (2024). Does volunteering decrease burnout? Healthcare professional and student perspectives on burnout and volunteering. *Frontiers in Public Health*, 12, 1387494. <https://doi.org/10.3389/fpubh.2024.1387494>
- Morrow-Howell, N., Hinterlong, J., Rozario, P.A., & Tang, F. (2003). Effects of volunteering on the well-being of older adults. *Journal of Gerontology Series B: Psychological Sciences and Social Sciences*, 58(3), 137–145. <https://doi.org/10.1093/geronb/58.3.s137>
- Musick, M.A., & Wilson, J. (2003). Volunteering and depression: The role of psychological and social resources in different age groups. *Social Science and Medicine*, 56(2), 259–269. [https://doi.org/10.1016/s0277-9536\(02\)00025-4](https://doi.org/10.1016/s0277-9536(02)00025-4)
- O'Connor, K., Muller Neff, D., & Pitman, S. (2018). Burnout in mental health professionals: A systematic review and meta-analysis of prevalence and determinants. *European Psychiatry*, 53, 74–99. <https://doi.org/10.1016/j.eurpsy.2018.06.003>
- Pallant, J. (2010). *SPSS survival manual: A step by step guide to data analysis using SPSS*. Open University Press/McGraw-Hill.
- Raemen, L., Claes, L., Buelens, T., Vankerckhoven, L., Van Oudenhove, L., & Luyckx, K. (2023). Personal identity, somatic symptoms, and symptom-related thoughts, feelings, and behaviors in adolescence: Examining between- and within-person associations and the role of depressive symptoms. *Journal of Youth and Adolescence*, 52(9), 1933–1949. <https://doi.org/10.1007/s10964-023-01811-9>
- Raquepaw, J.M., & Miller, R.S. (1989). Psychotherapist burnout: A componential analysis. *Professional Psychology: Research and Practice*, 20(1), 32–36. <https://doi.org/10.1037/0735-7028.20.1.32>
- Rosato, M., Tseliou, F., Wright, D.M., Maguire, A., & O'Reilly, D. (2019). Are volunteering and caregiving associated with suicide risk? A Census-based longitudinal study. *BMC Psychiatry*, 19, 296. <https://doi.org/10.1186/s12888-019-2255-8>
- Rosenberg, T., & Pace, M. (2006). Burnout among mental health professionals: Special considerations for the marriage and family therapist. *Journal of Marital and Family Therapy*, 32(1), 87–99. <https://doi.org/10.1111/j.1752-0606.2006.tb01590.x>
- Roth, L., Le Saux, C., Gilles, I., & Peytremann-Bridevaux, I. (2024). Factors associated with intent to leave the profession for the allied health workforce: A rapid review. *Medical Care Research and Review*, 81(1), 3–18. <https://doi.org/10.1177/10775587231204105>
- Rupert, P.A., & Kent, J.S. (2007). Gender and work setting differences in career-sustaining behaviors and burnout among professional psychologists. *Professional Psychology: Research and Practice*, 38(1), 88–96. <https://doi.org/10.1037/0735-7028.38.1.88>
- Russell, A.R., Nyame-Mensah, A., de Wit, A., & Handy, F. (2019). Volunteering and wellbeing among ageing adults: A longitudinal analysis. *VOLUNTAS: International Journal of Voluntary and Non-profit Organizations*, 30(1), 115–128. <https://doi.org/10.1007/s11266-018-0041-8>
- Sahebi, A., Nejati-Zarnaqi, B., Moayedi, S., Yousefi, K., Torres, M., Golitaleb, M. (2021). The prevalence of anxiety and depression among healthcare workers during the COVID-19 pandemic: An umbrella review of meta-analyses. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, 107, 110247. <https://doi.org/10.1016/j.pnpbp.2021.110247>
- Samaey, C., Lambrechts, S., Lecei, A., Achterhof, R., Hagemann, N., Hermans, K.S.F.M., Hiekkaranta, A.P., Kirtley, O. J., Reininghaus, U., Boets, B., Myin-Germeyns, I., & van Winkel, R. (2025). The role of identity in the development of depressive, anxiety and psychosis symptoms in adolescents exposed to childhood adversity: A process-oriented approach. *BMC Psychiatry*, 25, 194. <https://doi.org/10.1186/s12888-025-06649-y>
- Samios, C. (2018). Burnout and psychological adjustment in mental health workers in rural Australia: The roles of mindfulness and compassion satisfaction. *Mindfulness*, 9(4), 1088–1099. <https://doi.org/10.1007/s12671-017-0844-5>
- Sandberg, B., Hurmerinta, L., & Menzfeld, M. (2024). Volunteerism and community healing. *Community Development*, 55(6), 795–809. <https://doi.org/10.1080/15575330.2023.2301695>

- Schaffler, Y., Probst, T., Pieh, C., Haid, B., & Humer, E. (2024). Prevalence of mental health symptoms and potential risk factors among Austrian psychotherapists. *Scientific Reports*, *14*, 3888. <https://doi.org/10.1038/s41598-024-54372-7>
- Schaufeli, W.B., Bakker, A.B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A Cross-national study. *Educational and Psychological Measurement*, *66*(4), 701–716. <https://doi.org/10.1177/0013164405282471>
- Spitzer, R.L., Kroenke, K., Williams, J.B.W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine*, *166*(10), 1092–1097. <https://doi.org/10.1001/archinte.166.10.1092>
- Steger, M.F., Dik, B.J., & Duffy, R.D. (2012). Measuring meaningful work: The Work and Meaning Inventory (WAMI). *Journal of Career Assessment*, *20*(3), 322–337. <https://doi.org/10.1177/1069072711436160>
- Theocharis, A., Antonopoulos, V., Christodoulou, N.G. (2023). Somatic symptoms associated with mental distress during the COVID-19 pandemic: A systematic review. *Australasian Psychiatry*, *31*(2), 147–156. <https://doi.org/10.1177/10398562231156380>
- Thoits, P.A., & Hewitt, L.N. (2001). Volunteer work and well-being. *Journal of Health and Social Behavior*, *42*(2), 115–131. <https://doi.org/10.2307/3090173>
- Van Hoy, A., & Rzeszutek, M. (2022). Burnout and psychological wellbeing among psychotherapists: A systematic review. *Frontiers in Psychology*, *13*, 928191. <https://doi.org/10.3389/fpsyg.2022.928191>
- Wakefield, J.R.H., Bowe, M., & Kellezi, B. (2022). Who helps and why? A longitudinal exploration of volunteer role identity, between-group closeness, and community identification as predictors of coordinated helping during the COVID-19 pandemic. *British Journal of Social Psychology*, *61*(3), 907–923. <https://doi.org/10.1111/bjso.12523>
- Wang, H., Zhang, J., & Jia, H. (2019). Separate neural systems value prosocial behaviors and reward: An ALE meta-analysis. *Frontiers in Human Neuroscience*, *13*, 276. <https://doi.org/10.3389/fnhum.2019.00276>
- Zolotareva, A.A. (2022). Faktornaia struktura russkoiazychnoi versii shkaly somaticheskikh simptomov (somatic symptom scale-8, sss-8) [Factor structure of the Russian version of the Somatic Symptom Scale-8 (SSS-8)]. *Konsul'tativnaia psikhologiya i psikhoterapiia* [Counseling Psychology and Psychotherapy], *30*(3), 8–20. <https://doi.org/10.17759/cpp.2022300302>
- Zolotareva, A.A. (2023a). Adaptatsiia russkoiazychnoi versii shkaly generalizovannogo trevozhnogo rasstroistva (Generalized Anxiety Disorder-7) [Adaptation of the Russian version of the Generalized Anxiety Disorder-7]. *Konsul'tativnaia psikhologiya i psikhoterapiia* [Counseling Psychology and Psychotherapy], *31*(4), 31–46. <https://doi.org/10.17759/cpp.2023310402>
- Zolotareva, A.A. (2023b). Diagnostika depressii: psikhometricheskaia otsenka russkoiazychnoi versii oprosnika zdorov'ia patientsia (Patient Health Questionnaire-9, PHQ-9) [Diagnosis of depression: Psychometric examination of the Russian version of the Patient Health Questionnaire (PHQ-9)]. *Klinicheskaya i spetsial'naya psikhologiya* [Clinical Psychology and Special Education], *12*(4), 107–121. <https://doi.org/10.17759/cpse.2023120406>

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## Neuropsychological Assessment and Rehabilitation of Patients with Impaired Monitoring as a Component of Executive Functions

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**Background.** There is a high prevalence of impairments in executive functions in various neurological diseases (stroke, traumatic brain injury, neurodegenerative disorders), which severely limits patients' independence and quality of life. The study integrates the theory of the systematic, step-by-step formation of mental actions and concepts by Galperin, Luria's approach to neuropsychology, and modern foreign rehabilitation techniques (e.g., strategies from the "Goal Management Training" program).

**Objective.** To assess the impact of a specialized neuropsychological training program on monitoring process indicators in patients with brain damage of various etiology.

**Design.** The study involved 48 patients with brain damage of various etiology, aged from 23 to 74 years ( $M_{\text{age}} = 57.6$ ;  $SD = 11.13$ ; 17 women and 31 men). The patients were divided into an experimental group and a control group.

**Results.** A specialized training program aimed at improving monitoring process indicators in patients with impaired executive functions was developed, as well as a neuropsychological diagnostic protocol for assessing monitoring. We did not observe a training effect when comparing the monitoring index values before and after the training within the experimental group. However, we found significant differences between the experimental and control groups when analyzing the indices based on the results of the post-test assessment ( $U = 170$ ,  $p = .008$ ,  $p_{\text{bonferroni}} = .032$ ),

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executive functions,  
monitoring,  
neuropsychological rehabilitation,  
P.Ya Galperin's theory,  
restorative learning

along with significant improvements in five monitoring indicators and the total Frontal Assessment Battery score in the patients of the experimental group.

**Conclusion.** The training effect, when comparing the experimental and control groups at the post-test, may be interpreted within the framework of intra-systemic semantic reorganization and the initial formation of a new mental action of selection and implementation of a solution in which monitoring actively participates. This interpretation is preliminary and requires further empirical validation. In future research, we plan to focus the training on the formation of the mental action of control.

## Introduction

Executive functions serve regulatory, modifying, and directive roles for other mental and non-mental processes (Andrewes, 2015). Contemporary neuropsychological theories primarily distinguish components of executive functions (Andrewes, 2015; Diamond, 2013; Miyake et al., 2000; Stuss, 2011). A.R. Luria (2009) considered executive functions within the third functional brain unit. These functions are associated with the neuropsychological factor of “programming and control” attributed to the prefrontal (convexital) areas of the cerebral hemispheres (Khomskaja, 2006). Deficits in executive function are noted not only following lesions in the frontal areas, but also in other brain regions (*e.g.*, the parietal lobes, thalamus, or striatum) (Tyburski et al., 2018). Impairments of these functions are prevalent in neurological disorders, including stroke, traumatic brain injury, Huntington’s disease, Parkinson’s disease, Alzheimer’s disease, and frontotemporal dementia (Andrewes, 2015).

Among executive functions, the monitoring of performed activities is highlighted (Diamond, 2013; Khomskaja, 2006; Korsakova, 2012; Luria, 2009; Miyake et al., 2000; Stuss, 2011). For instance, Luria (2009) identified it as one of the core tasks of the third functional brain unit (programming, regulation, and control), while Stuss and Alexander (2007) discussed monitoring as a component of executive functions, localized in the right lateral prefrontal cortex, responsible for checking task performance over time for “quality control” and behavioral adjustment.

In rehabilitating patients with impaired executive functions, emphasis is placed on replacing internal regulation of mental processes with external support and presenting action programs in an externalized, detailed format (Tsvetkova, 2004). A primary method for restoring these functions involves creating conditions where patients can internalize action plans initially managed solely by the psychologist (Baulina et al., 2023). Within the Soviet and Russian neuropsychological tradition, the restoration of executive functions is primarily considered within the framework of restorative learning (Tsvetkova, 2004), including the application of Galperin’s method of the systematic, stage-by-stage formation of mental actions. International approaches note numerous methods for rehabilitating such patients with various training programs (Kennedy et al., 2008). According to the meta-analysis by Cicerone and colleagues (2011) of rehabilitation studies on patients with traumatic brain injury, only meta-cognitive strategy training merits a “practice standard” recommendation. A similar conclusion was reached in the meta-analysis by Kennedy et al. (2008), emphasizing

that metacognitive strategy training should be used with adults up to middle age who have sustained a traumatic brain injury, helping them in overcoming difficulties related to problem-solving, planning, and organization. Notably, their meta-analysis showed that metacognitive strategy training, compared to control interventions, significantly improved activity and participation outcomes but not impairment-level measures, highlighting the need to examine specific components such as monitoring in detail.

Another program used in rehabilitating patients with executive function deficits is “Goal Management Training” (GMT). It has been suggested that GMT is more likely to be successful when combined with other strategies, *e.g.*, problem-solving therapy, and when practiced in real-life situations (Krasny-Pacini et al., 2014). Developed by Levine and colleagues (2000), GMT targets components of executive functions like planning, decision-making, goal attainment, and problem-solving. A version of this program, offered by Winson et al. (2017), involves six stages: defining the main goal, generating potential solutions, weighing the pros and cons of each option, selecting a solution and planning steps, implementation with monitoring, and outcome evaluation. Winson et al. refer to the conceptual framework of Stuss, outlining specific strategies targeting distinct domains of executive functions. Based on these strategies, Shcherbakov et al. (2021) developed a neuropsychological rehabilitation training incorporating “Stop/Think” and “Zoom In/Out” techniques, along with a modified procedure derived from Goal Management Training.

A promising direction is the integration of modern rehabilitation methods with the fundamental principles of Galperin’s theory. For example, Kovyazina et al. (2025) designed a rehabilitation training program for patients with neglect syndrome that incorporates techniques by Winson et al. (2017) within the framework of the stage-by-stage formation of mental actions. The present study continues this line of research. Our training program is based on the principles of restorative learning (Luria, 1948; Tsvetkova, 2004), the method of step-by-step formation of mental actions and concepts by Galperin (Galperin, & Kabyĭnitskaia, 1974; Talyzina, 1998), and rehabilitation strategies developed by Winson and colleagues (2017).

## **Methods**

### ***Participants***

The sample consisted of 48 patients (17 women and 31 men), aged between 23 and 74 years, with neurological disorders of various etiology. The mean age was 57.6 years ( $SD = 11.13$ ). The experimental group had a mean age of 56.7 years ( $SD = 11.66$ ), and the control group had a mean age of 58.6 years ( $SD = 10.69$ ). Regarding clinical characteristics, in the experimental group ( $n = 25$ ), diagnoses were: ischemic stroke (15; 60%), traumatic brain injury (TBI) (5; 20%), hemorrhagic stroke and subarachnoid hemorrhage (SAH) (4; 16%), and mixed ischemic-hemorrhagic (1; 4%). In the control group ( $n = 23$ ): ischemic stroke (18; 78.3%), hemorrhagic stroke and SAH (3; 13%), post-TBI sequelae (1; 4.3%), and cerebral aneurysm (1; 4.3%)

Data on the exact time elapsed between the brain lesion event and the baseline assessment were not systematically recorded, although all patients were in the chron-

ic stage of recovery (at least three months post-event), and this limitation should be considered when interpreting the findings.

The patients were divided into two groups: an experimental group ( $n=25$ ) and a control group ( $n=23$ ). Participants were assigned to either the experimental or control group based on the order of admission to the rehabilitation center and the availability of training slots. This resulted in a quasi-experimental design, as randomization was not feasible due to the clinical setting and the need to ensure that all eligible patients could receive the intervention if they wished. Importantly, the groups were comparable at baseline in terms of age, sex, and diagnosis distribution, reducing the likelihood of systematic bias.

The inclusion criteria for both groups were mild to moderate impairments in executive functions, right-handedness, and a clear state of consciousness. Exclusion criteria were as follows:

1. Impairments in impressive or expressive oral speech, or severe reading disorders;
2. Severe neurodynamic and modality-nonspecific memory impairments;
3. Severe modality-specific impairments in auditory-verbal memory;
4. Perceptual disorders.

### ***Procedure***

The research was carried out from January 2024 to April 2025 at the Department of Medical Rehabilitation of Patients with Impaired Central Nervous System function, of the Pirogov National Medical and Surgical Center of the Ministry of Health of the Russian Federation.

We conducted an intergroup field experiment. The independent variable was the application of an intervention in the form of the executive functions training program. The dependent variable was the change in quantitative scores on the diagnostic measures of executive functions between pre- and post-assessments.

The experimental group underwent the executive functions training, and the control group received no experimental intervention. The experimental design can be classified as a pretest-posttest control group design (Kornilova, 2022). The time interval between the pre- and post-assessment was approximately 2–3 weeks for all patients, corresponding to the standard duration of inpatient rehabilitation. Both groups were assessed using the same diagnostic protocol at admission (pretest) and before discharge (posttest).

### ***Research Methods***

A comprehensive assessment of executive functions was conducted using tests from the Frontal Assessment Battery (FAB), the Tower of London task (Culbertson, & Zillmer, 1999), the Color-Word Interference Test (CWIT) from the Delis-Kaplan Executive Function System (Delis, Kaplan, & Kramer, 2001), as well as tests of proverb interpretation from Luria's classical neuropsychological assessment, the "Strange Stories" test (Happé, 1994), and "Bidstrup's picture sequences" task.

This test battery was designed to provide a comprehensive assessment of executive functions, alongside measurements of thinking, memory, attention, and the mo-

tor and visuospatial skills. Tasks involving memorization of phrases and a graphomotor test were included.

We hypothesized that the most sensitive indicators of monitoring from the FAB would be words from other grammatical categories, words not beginning with a certain letter, repetitions, proper nouns from the “Lexical Fluency” indicator; echopraxia from the “Conflicting Instructions”; and echopraxia, systematic perseverations without error awareness from the “Go-No Go”. These errors reflect disrupted adherence to instructions and lack of error awareness. Patients were instructed to inform the examiner if they made a mistake during the task.

In the Tower of London test (Culbertson, & Zillmer, 1999), the indicator chosen to assess monitoring was the total number of rule violations in the main series. This number was divided by the number of attempted tasks, as some patients refused to complete certain items. For the Color-Word Interference Test (CWIT) from the Delis-Kaplan system, the number of uncorrected errors in the main condition was selected as the criterion for evaluating monitoring.

We also used the “Strange Stories” test – a translated version of the instrument developed by Happé (Happé, 1994). In the “Strange Stories” (“The Gift” and “The Thief”), patients were required to read a text and then answer questions to assess their understanding of the characters’ behavior and emotions. For “Bidstrup’s picture sequences” (“In the Restaurant” and “The Snowman”), criteria similar to those for the “Strange Stories” were identified. To assess monitoring in these two tasks, indicators such as digressions into irrelevant associations and repetition of an incorrect answer after feedback were used, as they reflect a disruption in the ongoing verification of task performance for “quality control” and behavioral adjustment (Stuss & Alexander, 2007).

The indicators we identified for assessing monitoring in the FAB’s tasks, the tests of proverb interpretation, the “Strange Stories”, and “Bidstrup’s picture sequences” were rated on a scale from 0 to 2, where 0 corresponded to no impairment, 1 to moderate impairment or observed compensatory strategies, and 2 to severe deficits.

### *Methods of exposure*

The specialized neuropsychological training program consisted of four group sessions (60 minutes each). The training sessions for the experimental group were conducted on weekdays after 14:00 as an additional activity. The afternoon timing was chosen to fit the hospital schedule; however, it may have contributed to fatigue, which could have affected participants’ engagement during the sessions. Each session focused on one of the four components of executive functions outlined by Cicerone and colleagues (2006). The program included rehabilitation strategies developed by Winson et al. (2017) as well as our own techniques. During the second and third sessions, we applied P.Ya. Galperin’s method of the systematic, stage-by-stage formation of mental actions and concepts (Galperin & Kabylnitskaia, 1974; Talyzina, 1998). This was used to form the mental action of selecting and implementing a solution and to practice our modified version of the “Goal Management Training” (GMT) framework. In addition, our training was designed to foster social interaction; each session included psychoeducational components aimed at enhancing patients’ awareness of their deficits.

As an illustration, we will describe the second and third sessions, which were designed to practice strategies for overcoming difficulties with monitoring and to form the mental action of selecting and implementing a solution.

The second session, focused on “thinking and planning”, began with a brief theoretical psychoeducation block. Throughout the session, we worked with the patients to develop a scheme to address their “thinking and planning” difficulties. We gradually incorporated three techniques into this scheme: “Stop and Think”, “Pros and Cons”, and “Step by Step”. The scheme development was based on a modification of GMT presented by the Oliver Zangwill Centre (Winson et al., 2017).

The “Stop and Think” technique was practiced using a task involving packing a suitcase. The task instruction was: “You are going on a 10-day seaside trip and need to pack 10 essential items.” Patients were given cards depicting various objects. They were required to define their main goal using the “Stop and Think” technique and then select cards appropriate for that goal. The second technique, “Pros and Cons”, involved having patients evaluate the advantages and disadvantages of a potential decision before committing to it. To practice this, patients worked on a task requiring them to choose the optimal type of transport from Moscow to Saint Petersburg. The “Step by Step” technique highlighted the importance of decomposing a decision into concrete, sequential steps. To train this technique, patients completed a “metro” task, where they had to detail the steps to travel from one metro station to another, including a required transfer.

The third session was focused on further practicing the scheme and the three techniques (“Stop and Think”, “Pros and Cons”, and “Step by Step”) introduced in the second session. The goal of this session was to form a new mental action termed “selecting and implementing a solution”, which involved the process of monitoring. According to Galperin’s theory of the systematic, stage-by-stage formation of mental actions, the formation of a new mental action requires passing through five main stages (Galperin, 2023a). His later work emphasizes motivation as another crucial condition for the formation of mental actions (Galperin, 2023b).

The formation of the motivational basis for the action began with a group discussion. It is assumed that such a discussion, positive feedback from patients, and the opportunity to share one’s thoughts help foster motivation for the subsequent sessions (Grigor’eva, Kovyazina, & Tkhostov, 2013). Furthermore, patient psychoeducation served to establish this motivational foundation. At the beginning of the third session, we briefly reviewed the definition of the “thinking and planning” domain with the patients.

The second stage in forming a mental action involves creating an orienting basis for the action, which the patient will subsequently follow (Galperin, 2023a). During the rehabilitation sessions, we employed the orienting basis of an action of the third type, characterized by its completeness, generalizability, and the learner’s independence in applying it (Talyzina, 1998). This was realized through the scheme we developed with the patients in the second session. That scheme provided a complete set of operations necessary for performing the target action. The psychologist demonstrated how to apply the techniques using example tasks. The critical aspect of that stage was the externalization and fixation of the activity’s structure (Talyzina, 1998),

which we achieved by using a presentation that sequentially displayed the steps of the scheme as the psychologist explained them.

The third stage was characterized by the formation of the action in its materialized form. In addition to the scheme, patients were given practical assignments. For example, during the third session, patients were provided with printed copies of the scheme and asked to cross out each step as they completed it. They worked on practical tasks such as planning a trip or a birthday party at a country house. We would first ask patients what issues needed to be resolved before the trip and what goals should be set. Questions formulated by the participants, such as “where to go”, were then defined as the main tasks for the scheme. To solve the main task, patients had to go through all the steps of the scheme. We asked them to verbalize each step before execution and then to cross it out or place a checkmark next to it upon completion. Subsequently, the action was detached from physical objects and transferred to the plane of external speech (Galperin, 2023a). Accordingly, in the latter half of the third session, patients no longer crossed out steps on the paper, but instead verbalized them before execution.

It was anticipated that by the end of the course, patients would be at the stage of external speech acts. However, they would not have fully completed the next stage of forming the action in external speech to oneself, nor the final stage of formation, where the action is carried out in the form of internal speech as an individual process requiring no external support (Talyzina, 1998).

## **Results**

Statistical analysis of the quantitative data was performed using Jamovi software. Reliability was assessed using Cronbach’s alpha and McDonald’s omega; non-parametric tests (the Wilcoxon T-test and the Mann-Whitney U-test) were employed for group comparisons.

The primary objective was to create a composite monitoring index. Although exploratory factor analysis (EFA) is often recommended for validating composite measures, its use requires an adequate sample size (minimum 5 observations per variable (Hair Jr et al., 1998)). With 10 indicators, at least 50 participants would be needed, yet our total sample was 48. Given the risk of unstable and overfitted results, we refrained from EFA and instead relied on theoretical grounding and internal consistency (Cronbach’s  $\alpha$ , McDonald’s  $\omega$ ) to support the index.

To ensure its statistical reliability and internal consistency, Cronbach’s alpha coefficient was calculated. Prior to summing the scores from different tasks, the data were standardized, as the various parameters were measured on different scales. For instance, the number of uncorrected errors in the main condition of the “Color-Word Interference Test” was an interval-scale measure, whereas digressions into irrelevant associations in the “Bidstrup’s picture sequences” task were measured on an ordinal scale (0 to 2, with 0 indicating no impairment).

Thus, the final composite monitoring index included the following standardized scores from ten tasks: the score from the “Conflicting Instructions”; the total score from the “Go-No Go” task (both from the FAB); the repetition of incorrect answers and digressions into irrelevant associations from the “Proverb Interpretation”,

“Strange Stories”, and “Bidstrup’s picture sequences” tasks; as well as the total number of rule violations in the main series divided by the number of attempted items in the “Tower of London”; and the number of uncorrected errors in the “Color-Word Interference Test”.

The calculation of Cronbach’s alpha for the standardized scores of all indicators intended to measure monitoring revealed that the “internal consistency” of the scales  $\alpha = .587$ . The monitoring score from the “Lexical Fluency” of the Frontal Assessment Battery (FAB) correlated negatively with the total scale. Consequently, it was decided to exclude this indicator from the composite index. Following its exclusion, the “internal consistency” of the scales reached  $\alpha = .634$ . An additional analysis using McDonald’s omega yielded  $\omega = .661$ .

We planned to conduct a repeated-measures ANOVA for the monitoring index. As a preliminary step, Levene’s test was applied to assess the homogeneity of variances (see *Table 1*). The results indicated a violation of the homogeneity of variances for the initial measurement ( $F = 4.249, p = .045$ ). That finding invalidated the use of ANOVA in that case and required the application of non-parametric statistical tests.

**Table 1**

*Homogeneity of Variances Test (Levene’s) for the Monitoring Index Scores*

	F	df1	df2	p
Monitoring index (pretest)	4.249	1	46	.045
Monitoring index (posttest)	.446	1	46	.507

We applied the non-parametric Mann-Whitney U-test. The non-parametric Wilcoxon T-test for related samples to both the experimental and control groups was also conducted. Due to the execution of four pairwise comparisons (two between-group and two within-group), the Bonferroni correction was applied to control for Type I error, setting the significance level at  $\alpha = .0125$ .

The non-parametric Mann-Whitney U-test was used to analyze the differences in the monitoring index scores between the control and experimental groups at both the pre- and post-assessments (see *Table 2*).

**Table 2**

*Between-Group Comparisons of the Composite Monitoring Index at Pre- and Posttest Using the Mann-Whitney U Tests*

	Mann-Whitney T-test	P	$p_{\text{bonferroni}}$	Effect Size
Monitoring index (pretest)	284.0	.190	1.0	.012
Monitoring index (posttest)	170.0	.008	.032	.409

The data indicated that the patients in the experimental and control groups did not differ significantly at the pre-assessment ( $U = 284, p > .05, p_{\text{bonferroni}} > .05$ ). De-

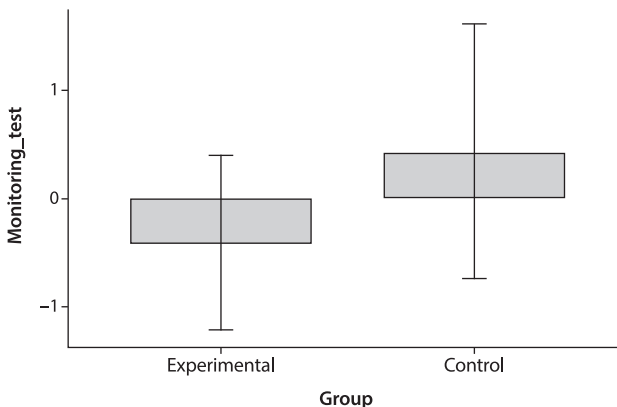
scriptive statistics for the composite monitoring index, where higher values indicate poorer performance, are presented in *Table 3*, *Figure 1* and *Figure 2*. At pretest, the control group had a marginally higher mean score ( $M = .45$ ,  $SD = 5.6$ ) than the experimental group ( $M = -.41$ ,  $SD = 4.05$ ).

**Table 3**

*Descriptive Statistics for the Monitoring Index*

	Group	Monitoring index (pretest)	Monitoring index (posttest)
N	Experimental	25	25
	Control	23	23
Mean	Experimental	-.413	-1.306
	Control	.448	1.420
Median	Experimental	-1.34	-2.767
	Control	-.846	.19
Standard deviation	Experimental	4.054	4.163
	Control	5.604	4.597
Minimum	Experimental	-5.764	-5.548
	Control	-6.478	-5.548
Maximum	Experimental	9.699	9.003
	Control	11.526	10.201

At the post-assessment, however, the groups differed significantly ( $U = 170$ ,  $p = .008$ ,  $p_{\text{bonferroni}} = .032$ ). The experimental group showed lower scores ( $M = -1.31$ ,  $SD = 4.16$ ) compared to the control group ( $M = 1.42$ ,  $SD = 4.6$ ). The effect size, calculated using the rank-biserial correlation coefficient, was .409, which corresponds to a moderate effect (Kerby, 2014).



*Figure 1.* Boxplot of the composite monitoring index at pretest

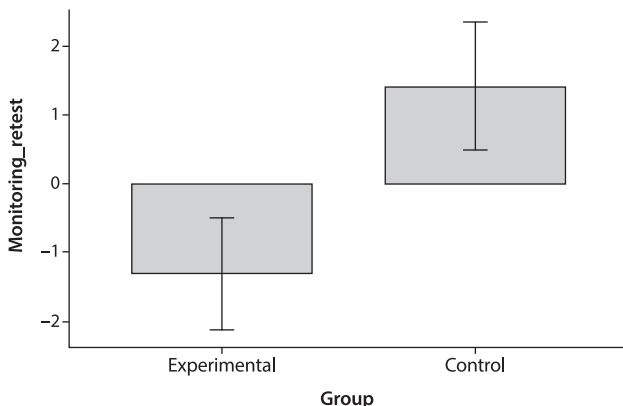


Figure 2. Boxplot of the composite monitoring index at posttest

At the post-assessment, however, the groups differed significantly ( $U = 170$ ,  $p = .008$ ,  $p_{\text{bonferroni}} = .032$ ). The experimental group showed lower scores ( $M = -1.31$ ,  $SD = 4.16$ ) compared to the control group ( $M = 1.42$ ,  $SD = 4.6$ ). The effect size, calculated using the rank-biserial correlation coefficient, was .409, which corresponds to a moderate effect (Kerby, 2014).

Using the Wilcoxon T-test, we assessed whether there were changes in the monitoring index scores within the experimental and control groups between the pre- and post-assessments. No significant differences were found between the test and retest scores for the experimental group ( $W = 196$ ,  $p > .05$ ,  $p_{\text{bonferroni}} > .05$ ) (see Table 4).

**Table 4**

*Within-Group Comparisons of the Composite Monitoring Index (Pre- vs Posttest) Using the Wilcoxon Signed-Rank Test*

	Wilcoxon T-test	<i>p</i>	Pbonferroni	Effect Size
Experimental group	196.0	.190	.76	.206
Control group	108.0	.820	1.0	-.217

In addition to the primary confirmatory analysis of the composite monitoring index, we conducted exploratory analyses of the individual monitoring indicators to identify potential patterns (see Table 5). Significant changes were found for five indicators, all of which showed strong effect sizes as estimated by the rank-biserial correlation coefficient.

We also used the Wilcoxon test to analyze changes in total FAB scores for both groups (Table 6). For the total FAB score, higher values correspond to better-preserved executive functions. The analysis revealed statistically significant differences for the experimental group ( $W = 196$ ,  $p < .05$ ) with a strong effect size (rank-biserial correlation,  $r = -.642$ ).

**Table 5**

*Exploratory analysis of Individual Monitoring Indicators: Within-Group Comparisons (Pre- vs Posttest) Using the Wilcoxon Signed-Rank Tests*

	Monitoring indicator	Wilcoxon T-test	P	Effect Size
Experimental group	FAB: "Conflicting Instructions": echopraxia	7.5	.212	.50
	FAB: "Go-No Go": composite index	30.0	.63	-.091
	"Strange Stories": error repetition	1.5	.681	0
	<b>"Strange Stories": digressions into irrelevant associations</b>	<b>31.5</b>	<b>.021</b>	<b>.75</b>
	<b>"Bidstrup's picture sequences": error repetition</b>	<b>40.5</b>	<b>.012</b>	<b>.80</b>
	<b>"Bidstrup's picture sequences": digressions into irrelevant associations</b>	<b>72.5</b>	<b>.003</b>	<b>.859</b>
	"Comprehension of proverbs": error repetition	17.500	.08	.667
	<b>"Comprehension of proverbs": digressions into irrelevant associations</b>	<b>46.0</b>	<b>.028</b>	<b>.673</b>
	CWIT: uncorrected errors in the main series	170.5	.078	.348
	<b>"Tower of London": total rule violations in the main series</b>	<b>164.0</b>	<b>.003</b>	<b>.726</b>

Note. *p*-values less than .05 are highlighted in bold.

**Table 6**

*Within-Group Comparisons of Total FAB Scores (Pre- vs Posttest) Using the Wilcoxon Signed-Rank Test*

	Wilcoxon T-test	P	Effect Size
Experimental group	196.0	.013	-.642
Control group	68.5	.521	.007

## Discussion

Cronbach's  $\alpha = .634$  indicates acceptable internal consistency, although a larger sample would provide a more stable estimate. This is consistent with findings in other studies. For instance, when constructing indices for specific neuropsychological factors in child samples, some indices also demonstrated only acceptable values (e.g., an index for serial organization of movements with  $\alpha = .63$ ) (Akhutina, 2022). However, in a more recent study by Bukinich et al. (2022) confirmatory factor analysis showed a good fit between the empirical data and the authors' model of indicators and fac-

tors, i.e., various components of higher mental functions. Bukinich and colleagues conclude that the indices possess sufficiently high structural validity, even those for which the Cronbach's alpha value had previously been only acceptable (Akhutina, 2022). The lexical fluency indicator was excluded from the composite monitoring index due to its negative correlations with other measures, consistent with the theoretical distinction between energization (assessed by verbal fluency) and monitoring (Stuss et al., 2006). This theoretical distinction may explain the negative correlations, as lexical fluency assesses energization — the capacity to generate and maintain actions or mental processes (Cicerone et al., 2006) — rather than monitoring, underscoring the need for future studies with separate measures of both components. After its exclusion, internal consistency reached an acceptable level (Cronbach's  $\alpha = .634$ ), further supported by McDonald's  $\omega = .661$ .

The significant between-group difference in the monitoring index supports the presence of an intervention effect (see *Table 2*); the non-significant within-group change in the experimental group (see *Table 4*) may reflect insufficient power. To determine whether our sample size was adequate to detect a meaningful within-group effect, we conducted an a priori power analysis using G\*Power. Based on the meta-analysis of metacognitive strategy interventions by Kennedy et al. (2008), which reported a pooled effect size of Hedges'  $g = .41$  for impairment-level outcomes, we estimated the sample size required for a paired Wilcoxon signed-rank test. With  $\alpha = .05$  and  $\beta = .80$ , the analysis indicated that a minimum of 40 participants would be necessary to detect an effect of this magnitude. Given that our experimental group comprised only 25 participants, the study may have been underpowered to detect within-group changes, which could account for the non-significant results.

We conducted a detailed exploratory analysis of each individual monitoring indicator within the experimental sample and found significant changes in specific parameters. These results indicate positive dynamics in the state of monitoring, yet improvements were confined to specific parameters.

The significant changes in the indicators of “repetition of an incorrect answer” and “digressions into irrelevant associations” are consistent with the hypothesis that patients were developing a new mental action of selecting and implementing a solution which was performed in an expanded form with verbalization by the end of the training. Specifically, the orienting basis of the action for this mental action included the step “stop and think”, where the patients were required to repeat the main task to themselves. For example, during the post-assessment tasks, such as “Bidstrup's picture sequences”, some patients from the experimental group were observed whispering the task to themselves. The significant change in the “Tower of London” indicator may be related to the training's emphasis on planning skills, which are central to both the GMT framework (Cicerone et al., 2006; Levine et al., 2000) and were specifically practiced during the formation of the mental action of selecting and implementing a solution. For example, the application of the “step by step” technique required patients to plan out their chosen solution in stages. However, as the specific mechanisms underlying this improvement were not directly assessed, this interpretation remains theoretical and requires further investigation.

We assessed changes in the total FAB score using the Wilcoxon T-test, which revealed significant differences in the experimental group, in contrast to the control group (see *Table 6*). We suggest that this indicates a positive influence of the training on executive functions as a whole.

In summary, the results based on the monitoring index from the comparison of experimental and control groups (see *Table 2*), individual tasks aimed at its assessment (see *Table 5*), and the total FAB score (see *Table 6*) point to positive dynamics in the state of monitoring and executive functions. These findings can be interpreted within the framework of intra-systemic reorganization (Luria, 1948; Tsvetkova, 2004). The strategies practiced during the sessions may have facilitated generalization of the material and contributed to a more conscious and voluntary level of performance, although this interpretation remains theoretical, as the mechanisms of reorganization were not directly assessed in the present study.

Furthermore, the goal of the second and third sessions was to form the new mental action named “selecting and implementing a solution”, which involved the process of monitoring. However, we cannot confirm that the patients progressed to the stage of mental action formation where the action is carried out in the form of internal speech as an individual process requiring no external support. Accordingly, by the end of the training, we had not succeeded in forming a mental action that was generalized, abbreviated, and automated. It may be hypothesized that, following the two-week training period, patients had reached the stage of external speech acts in the formation of the mental action. Whether participants internalized the action to the level of external speech, inner speech, or automated control remains an open question for future research.

Throughout the stage of external speech, the action of selecting and implementing a solution was performed by the patients in an expanded form, and its formation actively engaged monitoring as the process of checking task performance over time for “quality control” and behavioral adjustment. This suggests that the application of the method for the systematic, stage-by-stage formation of mental actions may have positively influenced the dynamics of monitoring.

For instance, during the post-test “Tower of London” task, one experimental patient verbalized the rules aloud and solved the task efficiently, whereas some controls needed repeated rule reminders. However, as the stage of mental action formation was not directly assessed, this interpretation remains tentative and requires further investigation.

The parameters of our training program are broadly consistent with those of studies included in recent meta-analyses of Goal Management Training (GMT) and metacognitive strategy interventions. Our sample of adults with stroke and TBI aligns with the populations most frequently studied in GMT research (Kennedy et al., 2008; Stamenova & Levine, 2019). Although our program was shorter (4 hours) than the 10–45 hours reported in meta-analyses, shorter GMT formats have also demonstrated significant results (Levine et al., 2000).

## Conclusion

The findings provide preliminary evidence for a training effect, as revealed by the comparison of monitoring index values between the experimental and control groups at the post-assessment. Furthermore, the exploratory analysis of differences in individual monitoring indicators within the experimental group indicated a trend toward change at the level of individual differences. The additional analysis also revealed that the total FAB score increased significantly in the experimental group, indicating an improvement in executive functions overall.

These results are consistent with the theoretical framework of intra-systemic semantic reorganization and may reflect the initial stages of forming the mental action of selecting and implementing a solution. However, as these constructs were not directly measured, this interpretation should be viewed as a hypothesis to be tested in future studies. As a result of the training, we cannot claim to have formed a mental action in its ideal, abbreviated, and automated form of control (Galperin, 1976). The mental action we aimed to form involved the monitoring process, but its object was not control *per se*; rather, it was the mental action associated with selecting and implementing a solution. Thus, this study has provided us with a better understanding of the future modifications required for a rehabilitation program to result in the formation of the mental action of control. By incorporating the principles of restorative learning more extensively, we plan to develop a specialized neuropsychological training program aimed at forming a mental action of control, where the object of the mental action would be control itself, and the goal would be the restoration of control as a parameter of executive functions.

Future study should also address the limitations of the present research through longitudinal designs with extended follow-up periods to assess the durability of training effects. The program should also be evaluated in other clinical populations (*e.g.*, Parkinson's disease, multiple sclerosis, mild cognitive impairment) and should examine potential moderators of treatment response, such as baseline severity, lesion location, and level of insight.

## Limitations

The mental action of selecting and implementing a solution, developed during the four sessions, appeared to improve patients' functioning, with observable benefits at the stage of external speech. Progressing through all six stages of Galperin's method would likely require additional sessions, which is feasible within a two-week rehabilitation stay.

Several limitations should be acknowledged. First, the modest sample size limited statistical power to detect within-group changes. Second, factors such as fatigue, additional training load, time since injury, age, and gender were not fully controlled. Third, the absence of a follow-up assessment limits conclusions about long-term maintenance of the observed effects. Furthermore, potential practice effects cannot be ruled out, as alternate test forms were unavailable for most tasks; minor modifications to some tasks do not fully eliminate this concern. Finally, the lack of blinded

evaluators introduces the risk of experimenter bias. These methodological issues should be addressed in future research.

### **Ethics Statement**

The study and consent procedures were approved by the Ethics Committee of Lomonosov Moscow State University (application #21-h, version 3, approved during the Bioethics Commission meeting #155-d held on 18.01.2024).

### **Author Contributions**

M.S. and N.A. conceived of the idea. I.A., A.Yu., and Yu.A. developed the theory. I.A. performed the computations and verified the analytical methods. All authors discussed the results and contributed to the final manuscript. All authors selected sources for the review and equally contributed to the analysis of the sources.

### **Conflict of Interest**

The authors declare that they have no conflicts of interest.

### **References**

- Akhutina, T.V. (2022). *Metody neiropsikhologicheskogo obsledovaniia detei 6-9 let* [Methods of neuropsychological assessment in 6–9-year-old children]. Izdatel'stvo V. Sekachev.
- Andrewes, D. (2015). *Neuropsychology: From theory to practice*. Psychology Press. <https://doi.org/10.4324/9781315652481>
- Baulina, M.E., Grigor'eva, V.N., Varako, N.A., Zinchenko, Yu.P., Kovyazina, M.S., Mikadze, Yu.V., Skvortsov, A.A., & Fufaeva, E.V. (2023). Neiropsikhologicheskaiia diagnostika i reabilitatsiia patsientov s narusheniiami regulatornykh (upravliaiushchikh) funktsii pri porazheniakh golovnogo mozga razlichnoi etiologii [Neuropsychological diagnostics and rehabilitation for patients with disorders of executive functions in brain diseases of various etiology]. *Natsional'nyi Psikhologicheskii Zhurnal* [National Psychological Journal], 18(4), 63–77. <https://doi.org/10.11621/npj.2023.0406>
- Bukinich, A.M., Korneev, A.A., Matveeva, E.Yu., Akhutina, T.V., Gusev, A.N., & Kreml'ev, A.E. (2022). Strukturnyi analiz rezul'tatov neiropsikhologicheskogo obsledovaniia detei 6-9 let [Structural analysis of neuropsychological data for 6–9-year-old children]. *Kul'turno-istoricheskaiia psikhologiia* [Cultural-Historical Psychology], 18(2), 21–31. <https://doi.org/10.17759/chp.2022180203>
- Cicerone, K., Levin, H., Malec, J., Stuss, D., & Whyte, J. (2006). Cognitive rehabilitation interventions for executive function: Moving from bench to bedside in patients with traumatic brain injury. *Journal of Cognitive Neuroscience*, 18(7), 1212–1222. <https://doi.org/10.1162/jocn.2006.18.7.1212>
- Cicerone, K.D., Langenbahn, D.M., Braden, C., Malec, J.F., Kalmar, K., Fraas, M., Felicetti, T., Laatsch, L., Harley, J.P., Bergquist, T., Azulay, J., Cantor, J., & Ashman, T. (2011). Evidence-based cognitive rehabilitation: Updated review of the literature from 2003 through 2008. *Archives of Physical Medicine and Rehabilitation*, 92(4), 519–530. <https://doi.org/10.1016/j.apmr.2010.11.015>
- Culbertson, C.W., & Zillmer, E. (1999). *Tower of London Drexel University (TOL DX): Examiner's manual*. Multi-Health Systems.
- Delis, D.C., Kaplan, E., & Kramer, J.H. (2001). *Delis-Kaplan executive function system TM: Examiner's manual*. The Psychological Corporation, Harcourt Assessment Company. <https://doi.org/10.1037/t15082-000>
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>

- Galperin, P.Ya. (1976). K probleme vnimaniia [On the problem of attention]. In A.N. Leont'ev, A.A. Puzyre, & V.Ya. Romanov (Eds.), *Khrestomatiia po vnimaniiu* [Reader on attention] (pp. 220–229). Moscow University Press.
- Galperin, P.Ya. (2023a). K voprosu o vnutrennei rechi [On the issue of inner speech]. In G.V. Burmenskaia (Ed.), *Psikhologii: predmet i metod. Izbrannye psikhologicheskie trudy* [Psychology: Subject and method. Selected psychological works] (pp. 328–335). Moscow University Press.
- Galperin, P.Ya. (2023b). Psikhologii myshleniia i uchenie o poetapnom formirovanii umstvennykh deistvii [Psychology of thinking and the theory of stage-by-stage formation of mental actions]. In: G.V. Burmenskaia (Ed.), *Psikhologii: predmet i metod. Izbrannye psikhologicheskie trudy* [Psychology: Subject and method. Selected psychological works] (pp. 620–657). Moscow University Press.
- Galperin, P.Ya., & Kabylnitskaia, S.L. (1974). *Ekspperimental'noe formirovanie vnimaniia* [Experimental formation of attention]. Moscow University Press.
- Grigor'eva, V.N., Kovyazina, M.S., & Tkhostov, A.Sh. (2013). *Kognitivnaia rehabilitatsiia bol'nykh s insultom i cherepno-mozgovoii travmoi: monografiia* [Cognitive rehabilitation of patients with stroke and traumatic brain injury: monograph]. Izdatel'stvo Nizhegorodskoi gosudarstvennoi meditsinskoi akademii.
- Hair Jr, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (1998). *Multivariate data analysis*. Prentice-Hall.
- Happé, F.G.E. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders*, 24(2), 129–154. <https://doi.org/10.1007/BF02172093>
- Kennedy, M.R.T., Coelho, C., Turkstra, L., Ylvisaker, M., Sohlberg, M.M., Yorkston, K., Chiou, H.H., & Kan, P.F. (2008). Intervention for executive functions after traumatic brain injury: A systematic review, meta-analysis and clinical recommendations. *Neuropsychological Rehabilitation*, 18(3), 257–299. <https://doi.org/10.1080/09602010701748644>
- Kerby, D.S. (2014). The simple difference formula: An approach to teaching nonparametric correlation. *Comprehensive Psychology*, 3(1), 1–9. <https://doi.org/10.2466/11.IT.3.1>
- Khomskaia, E.D. (2006). *Neiropsikhologii: Uchebnik dlia vuzov* [Neuropsychology: Textbook for universities]. Piter.
- Kornilova, T.V. (2022). *Ekspperimental'naia psikhologii. V 2 chastiakh. Ch. 1* [Experimental Psychology. In 2 parts. Part 1]. Izdatel'stvo YURAIT.
- Korsakova, N.K. (2012). Neiropsikhologicheskii faktor: nasledie A.R. Luria i zadachi razvitiia neiropsikhologii [The neuropsychological factor: The legacy of A.R. Luria and the tasks for the development of neuropsychology]. *Vestnik Moskovskogo Universiteta. Serii 14. Psikhologii* [Moscow University Psychology Bulletin, Series 14], 2, 8–15. <https://msupsyj.ru/articles/article/1566/#endnote3>
- Kovyazina, M.S., Varako, N.A., Stepanov, G.K., Yurina, D.D., Propustina, V.A., Vasil'eva, S.A., Daminov, V.D., & Zinchenko, Yu.P. (2025). The Use of Specialized Neuropsychological Training for the Rehabilitation of Patients with Neglect Syndrome. *Psychology in Russia: State of the Art*, 18(1), 3–18. <https://doi.org/10.11621/pir.2025.0201>
- Krasny-Pacini, A., Limond, J., Evans, J., Hiebel, J., Bendjelida, K., & Chevignard, M. (2014). Context-sensitive goal management training for everyday executive dysfunction in children after severe traumatic brain injury. *The Journal of Head Trauma Rehabilitation*, 29(5), E49–E64. <https://doi.org/10.1097/HTR.0000000000000015>
- Levine, B., Robertson, I.H., Clare, L., Carter, G., Hong, J., Wilson, B.A., Duncan, J., & Stuss, D.T. (2000). Rehabilitation of executive functioning: An experimental-clinical validation of Goal Management Training. *Journal of the International Neuropsychological Society*, 6(3), 299–312. <https://doi.org/10.1017/s1355617700633052>
- Luria, A.R. (1948). *Vosstanovlenie funktsii mozga posle voennoi travmy* [Restoration of function after brain injury]. Izdatel'stvo Akademii meditsinskikh nauk SSSR.
- Luria, A.R. (2009). *Osnovy neiropsikhologii: ucheb. posobie dlia stud. vyssh. ucheb. zavedenii* [Foundations of Neuropsychology: Textbook for university students]. Izdatel'skii tsentr "Akademiia".

- Miyake, A., Friedman, N.P., Emerson, M.J., Witzki, A.H., Howerter, A., & Wager, T.D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100. <https://doi.org/10.1006/cogp.1999.0734>
- Stamenova, V., & Levine, B. (2019). Effectiveness of goal management training in improving executive functions: A meta-analysis. *Neuropsychological Rehabilitation*, 29(10), 1569–1599. <https://doi.org/10.1080/09602011.2018.1438294>
- Shcherbakov, N., Varako, N., Kovyazina, M., Zueva, Y., Baulina, M., Skvortsov, A., & Chernikova, D. (2021). Dynamics of neuropsychological symptoms during the training of executive functions in neurological patients. *Healthcare*, 9(12), 1–12. <https://doi.org/10.3390/healthcare9121679>
- Stuss, D.T. (2011). Functions of the frontal lobes: Relation to executive functions. *Journal of the International Neuropsychological Society*, 17(5), 759–765. <https://doi.org/10.1017/S1355617711000695>
- Stuss, D.T., & Alexander, M.P. (2007). Is there a dysexecutive syndrome? *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362(1481), 901–915. <https://doi.org/10.1098/rstb.2007.2096>
- Talyzina, N.F. (1998). *Pedagogicheskaya psikhologiya* [Pedagogical psychology]. Izdatel'skii tsentr “Akademiiia”
- Tsvetkova, L.S. (2004). *Vosstanovlenie vysshikh psikhicheskikh funktsii (posle porazhenii golovnogo mozga)* [Restoration of higher mental functions (after brain damage)]. Akademicheskii Proekt.
- Tyburski, E., Mak, M., Kurpisz, J., Samochowiec, A., & Potemkowski, A. (2018). Zaburzenia funkcji wykonawczych po udarze mózgu — możliwości i ograniczenia diagnozy [Executive dysfunction after stroke possibilities and limitations of diagnosis]. *Postępy Psychiatrii i Neurologii* [Advances in Psychiatry and Neurology], 27(2), 135–145. <https://doi.org/10.5114/ppn.2018.77032>
- Winson, R., Wilson, B.A., & Bateman, A. (2017). *The Brain Injury Rehabilitation Workbook*. Guilford Press. <https://doi.org/10.1080/23279095.2017.1330452>

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